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ARMY PRELIMINARY EVALUATION PREPRODUCTION OV-ID (MOHAWK)

FINAL REPORT

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MARCH 1970

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US ARMY AVIATION SYSTEMS TEST ACTIVITY
EDWARDS AIR FORCE BASE, CALIFORNIA 93523

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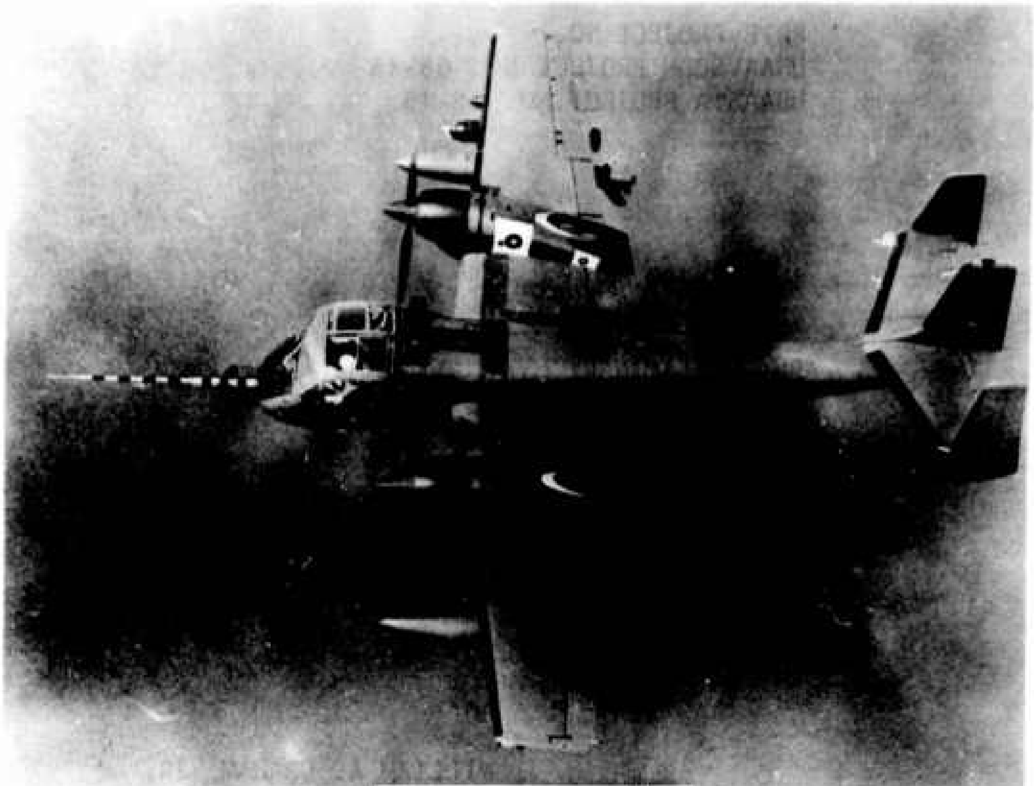

PREPRODUCTION OV-1D AIRPLANE

ABSTRACT

An Army Preliminary Evaluation of the preproduction OV-1D airplane (Mohawk) S/N 67-18899, was conducted by the US Army Aviation Systems Test Activity. During the period of this test, 33.9 hours were flown between 29 April 1969 and 14 May 1969 at Calverton, New York. The objective of this test was to evaluate performance and handling qualities of the airplane in various external store configurations. Inadequate single engine performance was the only deficiency noted. The airplane will not climb in the takeoff configuration with one engine feathered. There were also three major shortcomings noted. Pedal forces were excessive with one engine feathered. Stall warning margins in the landing and power approach configurations were insufficient. The lack of a cockpit accelerometer prevents the monitoring of "g" loads by the pilot. The vertical tape display instruments in the production OV-1D are a significant improvement over the previously used round dials.

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INTRODUCTION

BACKGROUND

1. The OV-1D airplane was designed to perform all the surveillance missions of previous OV-1 models (i.e., visual and photographic) with either the side-looking airborne radar (SLAR) or infrared surveillance systems, which are interchangeable. Four preproduction OV-1D aircraft were used in contractor flight tests to obtain and evaluate preliminary data on performance, flying qualities, electronics compatibility and structural integrity. The Army Preliminary Evaluation (APE) test of the preproduction OV-1D was directed by the US Army Aviation Systems Command (USAAVSCOM) in Test Directive No. 68-43 (ref 1, app I).

2. The APE was initially scheduled for February 1969 but was delayed until 29 April 1969 to permit stores loads and jettison testing by the contractor.

TEST OBJECTIVES

3. The objective of the APE was to conduct a limited quantitative and qualitative evaluation of those airplane performance and handling qualities which were influenced by airplane modification and the addition of various external stores.

DESCRIPTION

4. The OV-1D airplane (photo 1) flown in the APE was the preproduction OV-1D, S/N 67-18899, manufactured by the Grumman Aircraft Engineering Corporation. It is a midwing, triple vertical stabilizer, dual-engine turboprop airplane designed to perform combat surveillance and other related missions. The preproduction OV-1D is essentially a FY 67, OV-1C airplane with the exception of the following major modifications:

a. The fuselage is internally modified to accept quick change electronics equipment.

b. Two additional access doors are installed in the fuselage below the wing.

c. A blister for installation of a KA60( ) camera is located on the underside of the mid fuselage.

1. ALQ-80 Radar Jammer
2. LS-59A Flasher Pod
3. 150 Gallon Drop Tank
4. APS-94(D) SLAR
5. 150 Gallon Drop Tank
6. ALQ-67 Fuze Jammer (not shown: located under left wing tip)

Photo 1. External Stores Configurations

d. An AN/APS-94(D) SLAR is mounted on the lower right fuselage.

e. An AN/ALQ-80 radar jammer is mounted on the right wing.

f. An AN/ALQ-67 fuze jammer is mounted on the left wing.

g. It is powered by two Lycoming model T53-L-15 noncalibrated engines using Hamilton Standard 53C51 three-bladed propellers. The engines are each flat-rated at 1160 shaft horsepower (shp) to a 7500-foot pressure altitude (H_p).

h. There are three external stores configurations as defined in table 1. The airplane configurations are defined in table 2.

5. The production OV-1D will have T53-L-701 engines which develop 1400 shp at sea level (SL). Cockpit instrumentation in the test airplane is listed in appendix III. Production, as well as preproduction, cockpit configurations are illustrated in photos 2 and 3. Except for the flight control system, a detailed description of the OV-1D airplane is contained in reference 5, appendix I.

Table 1. External Stores Configurations.[1]

Configuration	External Stores Arrangement	
A	ALQ-80 radar jammer LS-59A flasher pod 150-gallon drop tank ALQ-67 fuze jammer APS-94(D) SLAR	Right wing station 237 Right wing station 213 Left and right wing station 185 Left wing station 237 Lower right fuselage
B	ALQ-80 radar jammer 150-gallon drop tank ALQ-67 fuze jammer APS-94(D) SLAR	Right wing station 237 Left and right wing station 185 Left wing station 237 Lower right fuselage
C	ALQ-80 radar jammer 150-gallon drop tank ALQ-67 fuze jammer	Right wing station 237 Left and right wing station 185 Left wing station 237

[1]See photo 1.

Table 2. Airplane Configurations.

Configuration[1]	Symbol	Landing Gear Position	Flap Setting (deg)	Power
Takeoff	TO	Down	15	TO
Power	P (climb)	Up	0	NRP
Cruise	CR	Up	0	PLF
Land	L	Down	45	Flight Idle
Power Approach	PA	Down	45	PLF[2]
Wave-off	WO	Down	45	TO
Dive	D	Up	0	Note[3]
Glide	G	Up	0	Flight Idle

[1]Configurations are defined in the military specification MIL-F-8785 (ASG)-2 (ref 6, app I).
[2]Power for level flight at 1.15 calibrated landing stall speed (V_{S_L}) or normal approach speed, whichever is lower.
[3]25% NRP or flight idle, whichever is greater.

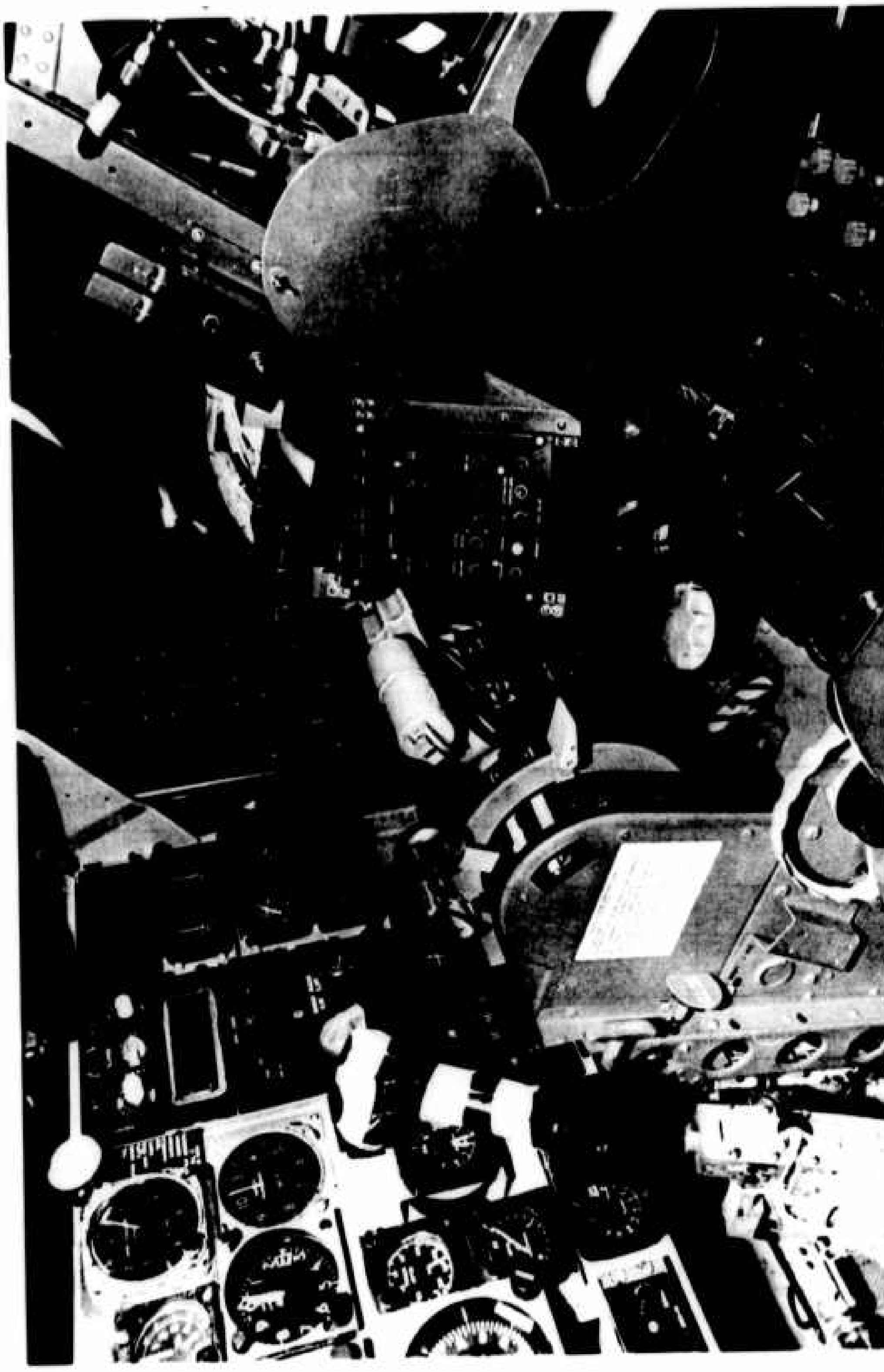


Photo 2. Cockpit - Preproduction OV-1D Airplane.

Photo 3. Vertical Tape Display - OV-1C Instrument Panel.

6. The flight control system is a reversible system including ailerons, elevators and rudders. In addition to the outboard ailerons, there are hydraulically powered inboard ailerons which are actuated when the flaps are down to provide additional control for takeoff and landing. All control surfaces are controlled from the cockpit using mechanical linkages from the rudder pedals and stick. A detailed description of the flight control system is contained in reference 3, appendix I.

SCOPE OF TEST

7. The flying qualities of the preproduction OV-1D were tested against the requirements of Military Specification MIL-F-8785 (ASG)-2, (ref 6, app I) hereafter referred to as the specification. The requirements as related to this airplane, were slightly modified by the detail specification (ref 4, app I).

8. The flying qualities and performance of the OV-1D airplane were evaluated within the limitations of the flight envelope and restrictions included in appendix V. A description of each test performed is found in the test plan (ref 2, app I).

9. The APE testing was conducted at the Grumman Aircraft Engineering Corporation test facility at the Peconic River Airport, Calverton, New York, from 29 April 1969 to 14 May 1969. Sixteen test flights were conducted for a total of 33.9 flight hours. The takeoff gross weight (grwt) of the airplane varied from 16,428 pounds to 17,600 pounds.

METHODS OF TEST

10. The test methods that were utilized are outlined in the test plan (ref 2, app I). Power required was determined by reading the test engine torque and rpm values from the photopanel data. Torquemeter readings were converted to foot pounds using the manufacturers engine calibration data. The source for power available, net thrust, propeller efficiency and installation losses was the Grumman Report XP134-10, *Installed Performance of the Lycoming T53-L-15 Engine as Estimated in the OV-1D Mohawk* (ref 7, app I).

CHRONOLOGY

11. The chronology of the OV-1D APE is as follows:

Test directive received	17 October 1968
Pre-APE conference held	26 March 1969
Test airplane received	29 April 1969
First APE flight	29 April 1969
Last APE flight	14 May 1969
Draft report submitted	August 1969

RESULTS AND DISCUSSION

PERFORMANCE

Dual Engine Level Flight

12. The dual engine level flight performance of the OV-1D was evaluated at pressure altitudes from 5000 to 15,000 feet. Tests were conducted at various gross weights and external stores configurations. Level flight drag polars are shown in figures 1, 2 and 3, appendix II, for the three stores configurations. Figures 4, 5 and 6 show the maximum specific range curves and recommended cruise speeds for various altitudes and gross weights for the three stores configurations. Stores configuration C gave the best specific range and highest recommended cruise speed for all altitudes flown while configuration A gave the lowest specific range and lowest recommended cruise speeds.

13. The recommended cruise airspeed of the airplane in stores configuration A (all external stores on board) at SL and at a 13,000-pound grwt was determined to be 177 knots, and at a 17,000-pound grwt, it was 192 knots. The endurance was determined to be 4.1 hours at a 5000-foot H_p and a 17,790-pound estimated grwt. All range and endurance calculations include fuel for taxi and takeoff (123 pounds), climb to 5000 feet (68 pounds) and a 10-percent fuel reserve.

14. Figure 7, appendix II, shows the maximum level flight true airspeed at a 5000-foot H_p to be 239 knots at a 13,000-pound grwt, and 235 knots at a 17,000-pound grwt. Figures 8 through 15 show additional dual engine level flight performance data. Airspeed calibration data are presented in figures 72 through 74.

Single Engine

15. Single engine level flight performance was evaluated at a 5000-foot H_p in stores configurations A and C. The results are presented in figures 16 through 22, appendix II.

16. Single engine climb performance was evaluated by the sawtooth climb method and by a single engine climb to service ceiling. The single engine service ceiling climb summary is shown for a standard day, cruise configuration and stores configuration A in figure 23, appendix II. At a representative 16,000-pound grwt, the single engine service ceiling is an 8400-foot H_p on a standard day with the operating engine maintained at military rated power

(MRP). The left engine was feathered.

17. A single engine climb performance summary is presented in table 3. It is noteworthy that the airplane will not maintain a positive rate of climb (R/C) in the takeoff configuration at a 15,000-pound grwt on a standard day or at a 13,000-pound grwt on a hot day. Additional single engine climb performance data are shown in figures 24 through 26, appendix II.

18. At a typical 17,000-pound mission grwt, the best climb airspeed in the cruise configuration is 124.6 KTAS. This is approximately 25 knots above the speed at which the aircraft will normally become airborne on takeoff and results in a R/C of only 228 fpm on a standard day in stores configuration A. If operation is anticipated from short strips which will require initial climb airspeeds slower than the best single engine R/C airspeed in order to clear obstacles, the single engine climb performance is unsatisfactory, and correction is mandatory. In such a situation, the pilot would not have sufficient altitude to establish the best R/C airspeed.

19. Although the production OV-1D airplane will be equipped with the T53-L-701 engines, hot day performance will not be improved. It is noteworthy that the proposed armor plate and the joint services in-flight data transmission systems (JIFDATS), which is currently under development for installation on production OV-1D airplanes, will increase the gross weight to approximately 19,000 pounds. Single engine performance will be further degraded at this higher gross weight.

20. Single engine climb performance was affected by the techniques employed. Two techniques were used. First, the aircraft was flown with the ball centered; second, zero sideslip was maintained which was equivalent to banking the aircraft approximately 4 degrees toward the operating engine. The second method (banking toward the operating engine) increased climb performance approximately 100 fpm.

Stall

21. Stalls were conducted in stores configurations A and C and in various airplane flight configurations at a 5000-foot Hp. All stalls were evaluated at the aft center of gravity (cg). Stall speed versus gross weight curves are shown in figure 27, appendix II, for both stores configurations A and C as defined in table 1. External stores configuration changes had no significant effect on stall speeds. The highest stall speed recorded was 94 knots calibrated airspeed (KCAS) at a 17,000-pound grwt in the

Table 3. Single Engine Climb Performance.
OV-1D (preproduction) USA S/N 67-18899

Configuration A
Sea Level, Standard Day

Gross Weight (lb)	Cruise Rate of Climb (fpm)[1]	Cruise Airspeed (KTAS)[2]	Takeoff Rate of Climb (fpm)	Takeoff Airspeed (KTAS)
13,000	857	114.2	280	99.3
14,000	681	117.1	108	101.0
15,000	513	119.9	-58	103.2
16,000	362	122.5	-207	106.0
17,000	228	124.6	-340	109.5

Configuration A
Sea Level, Hot Day (103°F)

Gross Weight (lb)	Cruise Rate of Climb (fpm)	Cruise Airspeed (KTAS)	Takeoff Rate of Climb (fpm)	Takeoff Airspeed (KTAS)
13,000	483	118.2	-55	99.8
14,000	329	120.5	-229	104.4
15,000	181	123.2	-387	108.5
16,000	43	126.3	-527	112.0
17,000	-80	130.0	-650	114.6

[1]Feet per minute.
[2]Knots true airspeed.

glide configuration (defined in ref 2, app I). Adding power for level flight decreased the stall speeds to approximately 70 KCAS. In general stall speeds decreased approximately 3 knots per 1000-pound decrease in gross weight.

STABILITY AND CONTROL

Stalls

22. Stalls were evaluated in external stores configurations A and C in the glide (G), cruise (CR), land (L) and power approach (PA) airplane configurations at an aft cg. Stall warning was defined by buffet and roll oscillations. There was also some aileron feedback. Lateral control effectiveness remained good until the stalls occurred. There was no discernible nonlinear increase in longitudinal stick force prior to the stall. Figures 28a through 29b, appendix II, are time histories of several stalls and show the various parameters. Stall warning margins were evaluated qualitatively by the pilots. The stall characteristics are listed in table 4. The warning margins averaged only 2 knots in the landing configuration and 4 knots in the power approach configuration. The light buffet could be partially masked by turbulence. The margins were unsatisfactory in the landing configuration and did not meet the requirements of paragraph 3.6.3 of the specification. In general, all stalls were characterized by a nose-down pitch except in the landing configuration where the stall was characterized by a left roll. Recovery from all stalls was readily accomplished by relaxing pressure on the stick. Correction of the low stall warning margins is desirable. Improved aerodynamic stall warning or installation of an artificial stall warning device is recommended (PRS 4) (see app VII).

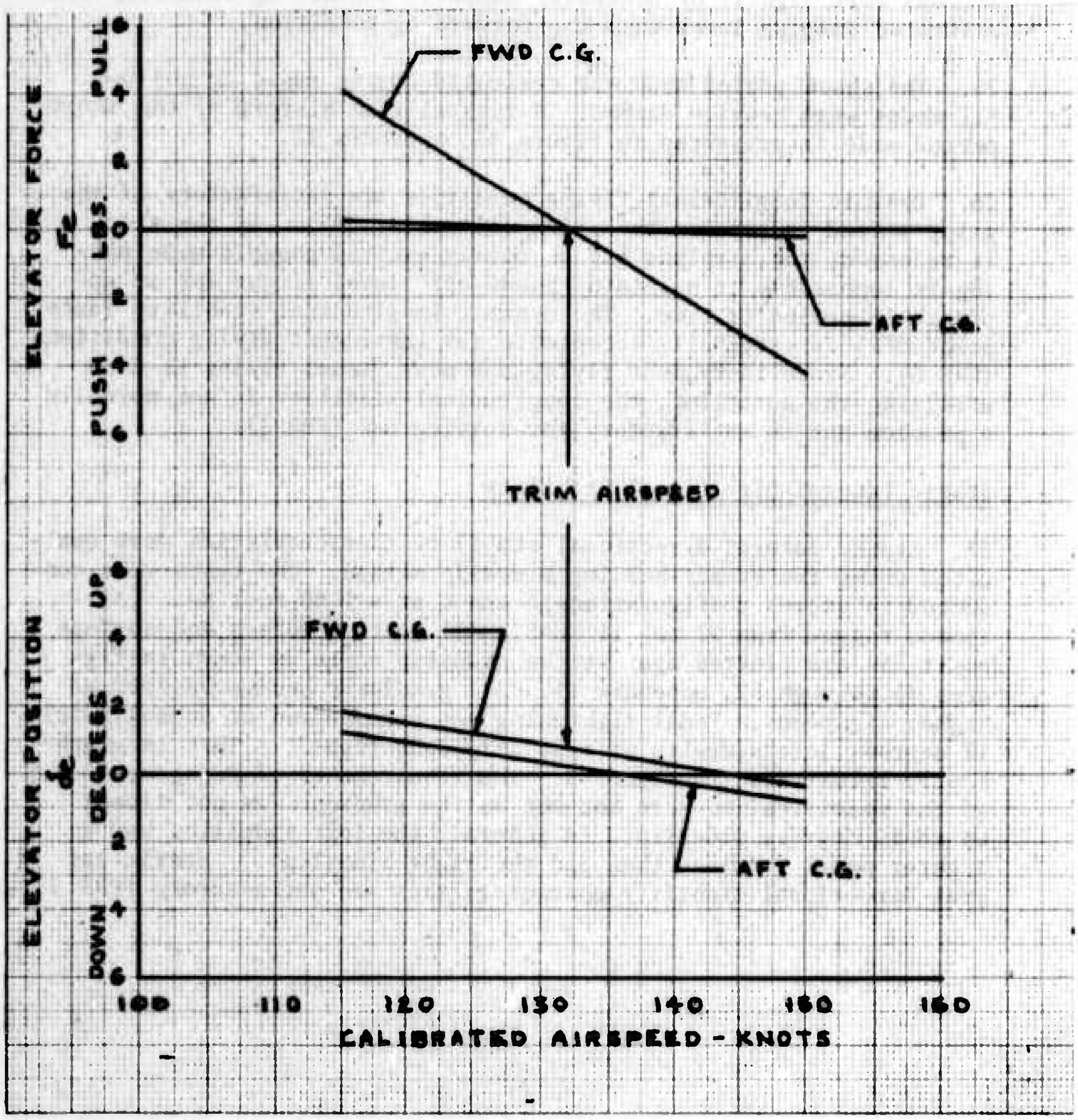
Static Longitudinal Stability

23. Static longitudinal stability was evaluated at a 5000-foot H_p in external stores configurations A and C at trim airspeeds ranging from 90 to 202 KCAS. Tests were conducted at both forward and aft cg. Elevator force and position are presented as a function of calibrated airspeed and lift coefficient in figures 30 through 37, appendix II. All gradients were positive for both force and position. The gradients decreased approaching zero as airspeed increased at approximately 200 KCAS in the cruise configuration. The elevator position gradient did not vary significantly with changes in cg. A comparison of cg effects on stick-free and stick-fixed stability is shown in figure A. Static longitudinal stability characteristics are satisfactory and comply with the requirements of the specification (PRS 2).

Figure A. Static Longitudinal Stability.
OV-1D (Preproduction) USA S/N 67-18899

STICK FIXED AND STICK FREE

Gross Weight	16,500 lbs
Pressure Altitude	5000 ft
Stores Configuration	C



Dynamic Longitudinal Stability

24. Dynamic longitudinal stability tests were conducted to evaluate the short- and long-period characteristics of the airplane. Tests were conducted at a 5000 foot H_p in external stores configurations A and C at forward and aft cg. Trim airspeeds were 135 and 160 KIAS. The phugoid data are presented as time histories of airspeed in figures 38 through 41, appendix II. All of the configurations were lightly or neutrally damped. The aft cg condition demonstrated damping lower than the forward cg condition.

25. The short period mode was evaluated during rapid 2g pullups. All modes were heavily damped. A typical time history of the short period mode is presented in figure 42, appendix II.

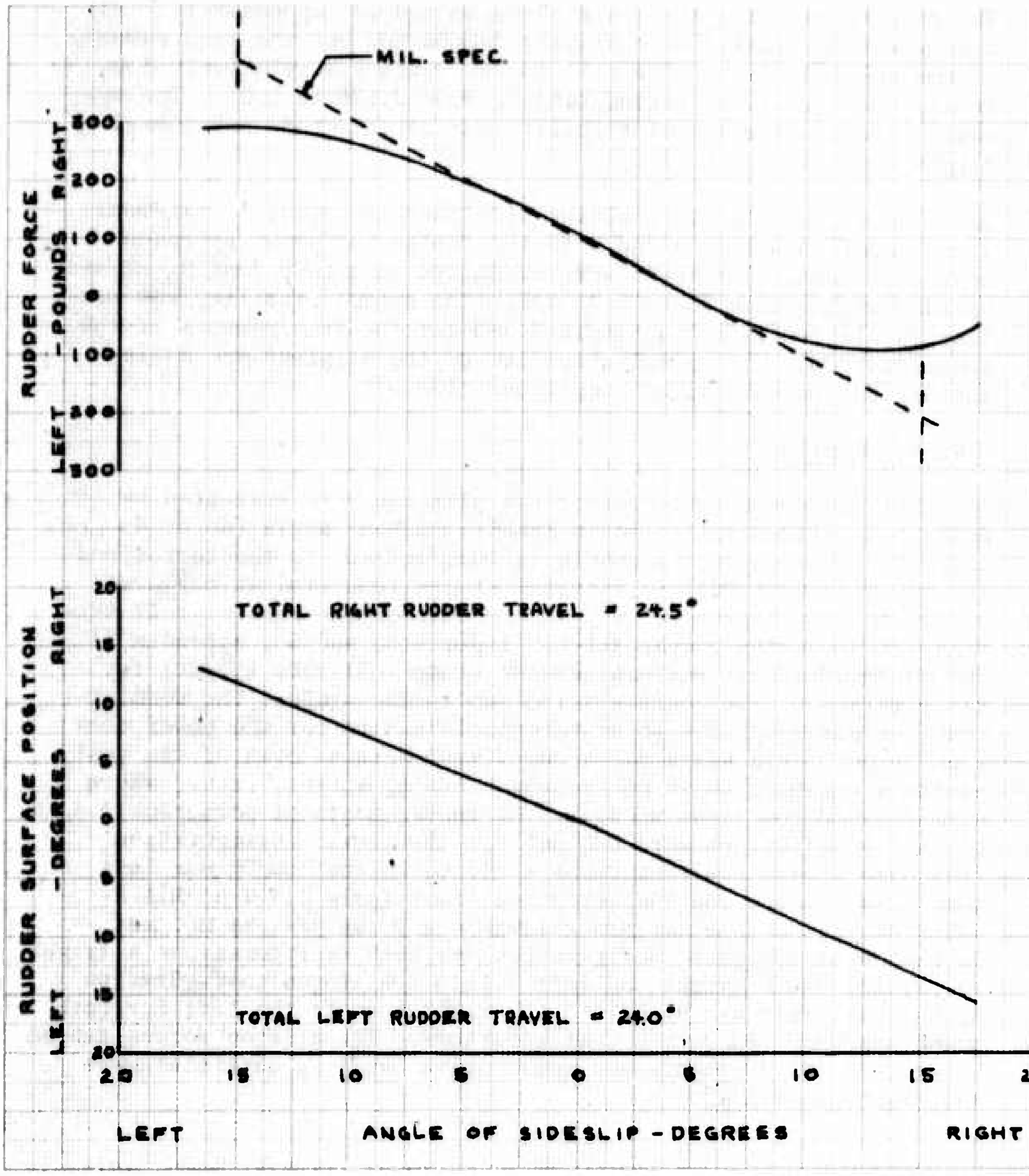
26. Dynamic longitudinal flying qualities are satisfactory if the pilot's hand is kept on the stick (autopilot OFF). If the stick is released, the airplane has an easily excited phugoid mode making it impossible to maintain "hands-off" level flight for an appreciable period of time. The dynamic longitudinal stability (autopilot OFF) is marginally acceptable for instrument flying conditions (PRS 5). Since instrument flying and most visual flying is done utilizing the autopilot, the longitudinal stability is not normally a problem and is satisfactory for service use (PRS 2).

Static Lateral-Directional Stability

27. Static lateral-directional stability characteristics were evaluated using the steady-heading sideslip method. The tests were conducted in stores configurations A and C at a 5000-foot H_p. Airspeeds ranged from 92 to 211 KCAS. All control forces and surface positions are plotted against the sideslip angle as shown in figures 43 through 52, appendix II. All gradients became steeper at higher airspeeds. Pedal lightening was encountered at approximately 12 degrees left sideslip at most airspeeds tested. This is graphically illustrated in figure B. The requirements of paragraph 3.4.5 of the specification were not met as the gradient was not linear up to 15 degrees sideslip. In general, the left sideslips had a lighter pedal gradient than did the right sideslips. Static lateral-directional stability characteristics are satisfactory (PRS 2).

Figure B. Static Lateral-Directional Stability.
OV-1D (Preproduction) USA S/N 67-18899

Calibrated Airspeed	130 knots
Gross Weight	14,200 lbs
Center of Gravity	MID
Pressure Altitude	5000 ft
Stores Configuration	A



Dynamic Lateral-Directional Stability

28. The dynamic lateral-directional stability of the airplane was tested in external stores configurations A and C at equivalent airspeeds ranging from 88 to 212 knots. The dutch roll mode was evaluated by the steady sideslip release method and by rudder pulsing. The results are presented in figures 53 and 54, appendix II. All configurations tested were heavily damped and met the requirements of the specification. The roll-to-yaw ratio was relatively low in all configurations tested ranging from 0.576 to 1.07. The dynamic lateral-directional stability was satisfactory for normal flight conditions (PRS 2).

29. The spiral stability of the airplane was tested in external stores configurations A and C in the cruise and power approach configurations. The tests were conducted at a 5000 foot H_p at airspeeds ranging from 95 to 160 KIAS. The spiral stability was neutral in all configurations tested and met the requirements of the specification. The spiral stability of the airplane was satisfactory for normal flight conditions (PRS 3).

Lateral Control

30. Rolling characteristics of the airplane were evaluated by doing pedal-fixed rolls from a stabilized bank angle (60 or 45 degrees depending on the configurations tested) to the corresponding opposite bank angle. External stores load limitations precluded the 360-degree rolls. The results of the rate-of-roll testing are presented graphically in figures 55 and 56, appendix II. The nondimensional, maximum, steady state roll rate (pb/2v) for the airplane cruise configuration was tested against the requirements of paragraph 3.4.16 of the specification for the power configuration. This was a valid comparison because some of the test points overlapped those of the power configuration, (i.e., where normal rated power was used). The requirements of paragraph 3.4.16 of the specification were not met for the cruise configuration (for both stores configurations A and C) in that pb/2v was less than 0.09. Also, the specification limit (para 3.4.9 of MIL-F-8785) of a 15-degree maximum allowable adverse yaw was not met in the power approach configuration for both configurations A (right roll only) and C (right and left roll). In stores configuration A, the roll rate was higher to the right than to the left for both power approach and cruise configurations. The aileron forces ranged between 30 and 40 pounds and qualitative handling qualities were satisfactory (PRS 2).

Single Engine Minimum Control Speed

31. Tests were conducted to determine minimum control speed (V_{MC}) and airplane control characteristics following an engine failure. The tests were conducted both in external stores configurations A and C in the cruise and takeoff configurations with the critical (left) engine feathered and unfeathered and in stores configuration A in the airplane wave-off configuration. The tests were conducted by slowly decelerating the airplane to the speed at which lateral or directional control could not be maintained.

32. In general, the V_{MC} was approximately 2 knots higher with the left engine feathered than with it unfeathered. The results of the testing are presented in table 5.

33. It was found that the technique employed made a significant difference in the V_{MC} obtained. Banking the airplane toward the operating engine improved the minimum control speed by approximately 5 knots as compared with keeping the wings level and the ball centered. It is recommended that this technique be presented in the operator's manual.

34. The high, rudder pedal force required is a major shortcoming. Should an engine fail on or immediately after takeoff, the average pilot would probably not be anticipating the high, rudder pedal force required and, therefore, may not apply necessary force in time to prevent loss of the airplane. This is especially true in light of the single engine performance problems discussed in paragraph 18. The pedal forces (listed in table 5) could not be trimmed out. Transient forces resulting from a sudden engine failure can be expected to be larger than those encountered during the gradual deceleration test techniques. Also, the increased power of the production engines at SL on a standard day will further degrade single engine controllability by increasing roll and yaw toward the nonoperating engine. Although the requirements of paragraph 3.4.12 of the specification were met, correction of the high, single engine, rudder pedal force is desirable (PRS 5).

Table 5. Single Engine Minimum Control Speed.

OV-1D (Preproduction) USA, S/N 67-18899

Configuration A

Aircraft Configuration	Gross Weight (lb)	Center of Gravity (% MAC[1])	Trim Airspeed (KCAS)	Pressure Altitude (ft)	Minimum Control Speed (KCAS)	Characteristics	
CR[2]	16,750	29.2	V_H[3]	5000	[4]100.9	Full right aileron	250-pound pedal force
CR	16,800	29.2	V_H[3]	5200	[5]94.7	Full right pedal/aileron	250-pound pedal force
TO[6]	16,600	29.2	106.5	4500	[4]92.7	Full right pedal	170-pound pedal force
TO	16,650	29.2	106.5	4900	[5]92.7	Full right pedal	175-pound pedal force
WO[7]	15,100	28.9	96.3	5000	[4]95.2	Full right pedal	180-pound pedal force
WO	15,100	28.9	96.3	4800	[5]91	Full right pedal	180-pound pedal force

Configuration C

Aircraft Configuration	Gross Weight (lb)	Center of Gravity (% MAC)	Trim Airspeed (KCAS)	Pressure Altitude (ft)	Minimum Control Speed (KCAS)	Characteristics	
CR	16,600	29.7	V_H[3]	5350	[4]106.9	Full right pedal	250-pound pedal force
CR	16,700	29.7	V_H[3]	5500	[5]104.9	Full right pedal	300-pound pedal force
TO	16,450	29.8	149	4600	[4]95.9	Full right pedal	170-pound pedal force
TO	16,500	29.8	149	5000	[5]94.9	Full right pedal	140-pound pedal force

[1]Mean aerodynamic chord.
[2]Cruise.
[3]Maximum level airspeed at military rated power.
[4]Feathered propeller.
[5]Unfeathered propeller.
[6]Takeoff.
[7]Wave-off.

Maneuvering Stability

35. The maneuvering stability characteristics of the airplane were evaluated using symmetric pullups and windup turns. The maneuvering stability force gradients were positive in all configurations tested. The results are presented in figures 57 through 68, appendix II. In general, the stick force per "g" decreased as airspeed increased up to 265 knots and then increased at 300 knots. The stick force gradient curve (the lightest being 10.4 pounds per "g" at 265 KCAS) is shown in figure C. The data indicate that the stick force per "g" requirements of paragraph 3.3.9 of the specification were not met at 197 KCAS (fig. 66, app II). The force per "g" was light enough to permit inadvertent overstressing of the aircraft if the pilot did not closely monitor the accelerometer. The production airplane will be limited to a maximum normal acceleration of 4g's. The lack of a cockpit accelerometer in the production aircraft is a shortcoming because there is no way for the pilot to monitor normal acceleration forces. Installation of an accelerometer in the cockpit is desirable. The maneuvering characteristics are satisfactory for Army use (PRS 2).

Longitudinal Trim Changes

36. Tests were conducted to determine the longitudinal trim changes caused by variations in power, flap position and gear operation. The results of the trim changes are presented in tables 6 and 7. In general, all control forces were light, ranging from 2 to 11 pounds, with one exception. In level flight at maximum velocity, a sudden reduction from military power to flight idle resulted in a nose-down pitch which required an aft stick force of approximately 20 pounds to correct. The 11-pound control force occurred when power was reduced to flight idle in the power approach configuration. Although two forces exceeded the 10-pound limit imposed by paragraph 3.3.19 of the specification, similar trim changes in the other stores configuration tested were within limits. The difference may be attributed to variations in pilot technique. The test data indicate that the requirements of paragraph 3.3.19 of the specification would be met.

Trimmability

37. Trimmability tests were conducted in various external stores and airplane configurations to determine the capability of the trimming devices to reduce the elevator, rudder and aileron control

Figure C. Maneuvering Stability.
OV-1D (Preproduction) USA S/N 67-18899

DIVE CONFIGURATION - SYMMETRICAL PULL-UP

Calibrated Airspeed	265 knots
Gross Weight	15,000 lbs
Center of Gravity	FWD
Pressure Altitude	3800 ft
Stores Configuration	C

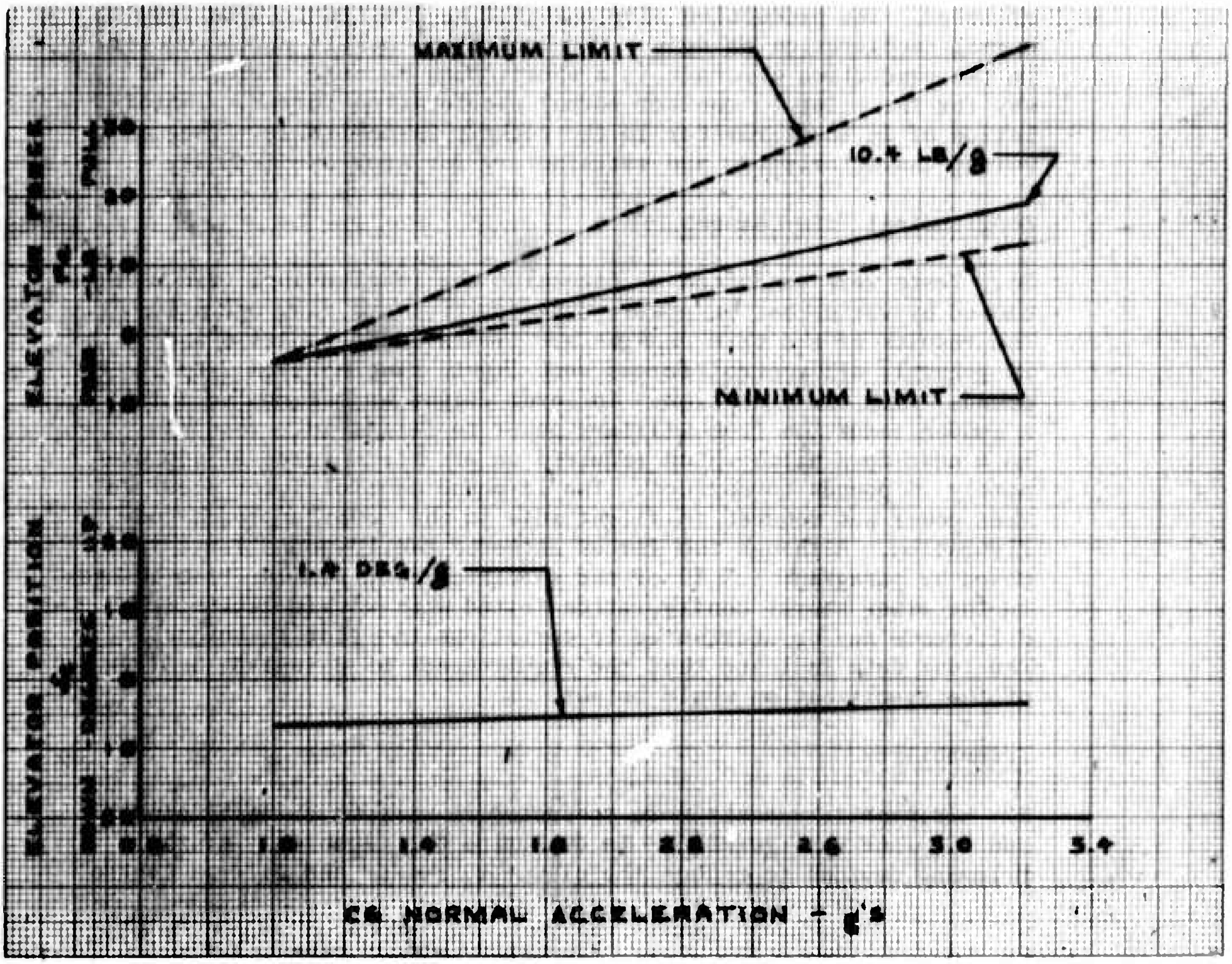


Table 6. Longitudinal Trim Changes.

OV-1D (Preproduction) USA, S/N 67-18899

Stores Configuration A

Initial Trim Condition					Configuration Change	Parameter Held Constant	Change in Longitudinal Stick Force (lb)
Airspeed (KCAS)	Altitude (ft)	Gear Position	Flap Angle (deg)	Power			
129.5	3900	Up	0	PLF[1]	Gear down	Altitude	3 push
128.5	4750	Down	0	PLF[1]	Flaps 45°	Altitude	4 pull
109	4700	Down	45	PLF[1]	Flight idle power	Airspeed	11 push
91	4850	Down	45	PLF[1]	Takeoff power	Altitude	8 push
92.7	4300	Down	15	TO[2]	Gear up	R/C	5 push
107.6	2250	Up	15	TO[2]	Flaps 0°	R/C	2 push
213	2800	Up	0	MRP[3]	Flight idle power	Altitude	9 pull

[1]Power for level flight.
[2]Takeoff.
[3]Military rated power.

Table 7. Longitudinal Trim Changes.

OV-1D (Preproduction) USA, S/N 67-18899

Stores Configuration C

Initial Trim Condition					Configuration Change	Parameter Held Constant	Change in Longitudinal Stick Force (lb)
Airspeed (KCAS)	Altitude (ft)	Gear Position	Flap Angle (deg)	Power			
127.4	4950	Up	0	PLF[1]	Gear down	Altitude	6 pull
121.2	5200	Down	0	PLF[1]	Flaps 45°	Altitude	6 pull
105.8	5200	Down	45	PLF[1]	Flight idle power	Airspeed	6 push
87.6	5000	Down	45	PLF[1]	Takeoff power	Altitude	6 push
94.9	6500	Down	15	TO[2]	Gear up	R/C[3]	6 push
109.7	6200	Up	15	TO[2]	Flaps 0°	R/C	6 push
222.4	5200	Up	0	MRP[4]	Flight idle power	Altitude	20 pull

[1]Power for level flight.
[2]Takeoff.
[3]Rate of climb.
[4]Military rated power.

forces to zero. The results of the testing are presented in figures 69 and 70, appendix II. Although most of the control forces could be reduced to zero, it was difficult to keep the airplane in trim. The lateral trim was very sensitive to slight variations in airspeed (on the order of 2 knots). Lateral trim was also affected greatly by uneven fuel burnout which caused an assymmetric load of approximately 300 pounds in the right drop tank when the left tank was empty. This problem is only significant for a fraction of the total flying time for an average mission and can be pilot controlled by monitoring and regulating the fuel used from each drop tank. The lateral trim limit was reached in level flight in airplane configurations P and L (table 2) and stores configuration A at airspeeds of 90 and 114 KCAS, respectively. The trimmability requirements of paragraph 3.5.4 of the specification were not met for configuration L. The lateral and longitudinal trimmability of the airplane was marginally acceptable (PRS 4).

MISCELLANEOUS

38. The heavy assymmetric stores configuration causes a right wing heavy condition which is objectional during taxi and creates a lateral-directional control problem during landing in high crosswinds from the left. It does not appear that the AN/ALQ-67 fuze jammer (located on the left wing) will be purchased for the production aircraft. This will further aggravate the asymmetric loading problem. This could be partially alleviated by locating the AN/ALQ-80 on the best wing suitable to the mission requirements. Satisfactory landings were made in cross-winds up to 15 knots. Further testing at higher cross-wind components is recommended to evaluate lateral-directional control during landing.

39. The cockpit air conditioning system does not provide adequate cooling for ground taxi. For even marginal airflow, one engine must be run at a 70-percent compressor rpm and feathered to prevent high taxi speed which results in excessive fuel consumption and objectionable vibrations. Correction of the cockpit cooling system is desirable to permit taxi at lower power settings.

40. Because of the increased gross weight of the OV-1D, the anticipated further increase of 2000 pounds with JIFDATS and armor plate, and the increase in standard day horsepower of the production engines, further testing is recommended. This testing should include takeoff and landing performance, single engine performance and single engine minimum control speed. Additional testing at higher gross weights is also recommended to determine the effect of operating on unimproved fields since there has been no increase in the landing gear flotation of the OV-1D.

COCKPIT EVALUATION

41. The vertical tape display indicators to be installed in the production OV-1D airplane are recognized as a significant improvement over the round dials. These indicators were evaluated in the OV-1C airplane used for chase missions and were easy to read during a quick scan of all engine parameters. The test airplane cockpit instrumentation are compared in photos 2 and 3, respectively.

42. The absence of a speed brake warning light in the cockpit is a shortcoming. In a high drag configuration (specifically on final approach), the pilot may not be aware that the speed brakes are extended. In the event of a wave-off, this could result in a dangerous situation. Installation of a speed brake warning light is desirable.

43. The INT control panel was located in a relatively inaccessible position at the rear of the center console. It is extremely difficult for the pilot to see the channel to which he is tuned. In addition, the six receiver switches on the panel can be inadvertently turned ON or OFF by merely placing a helmet bag, map case or other loose items on the rear of the console. Relocation of the INT control panel to a more accessible position and the installation of guards to protect the receiver switches are recommended. A suggested location is the space immediately aft of the automatic navigation coupler in the center of the console. The production airplane console is shown in photo 4.

44. The autopilot circuit breaker and navigational instrument circuit breakers have been moved from the cockpit to the battery compartment (photo 5). This could result in aborted SLAR missions since there is no way to reset the autopilot in the air if it trips a circuit breaker (the autopilot is required for SLAR missions). This could also result in an undesirable situation during instrument flying conditions. Relocation of these circuit breakers from the battery compartment to an accessible location in the cockpit is desirable.

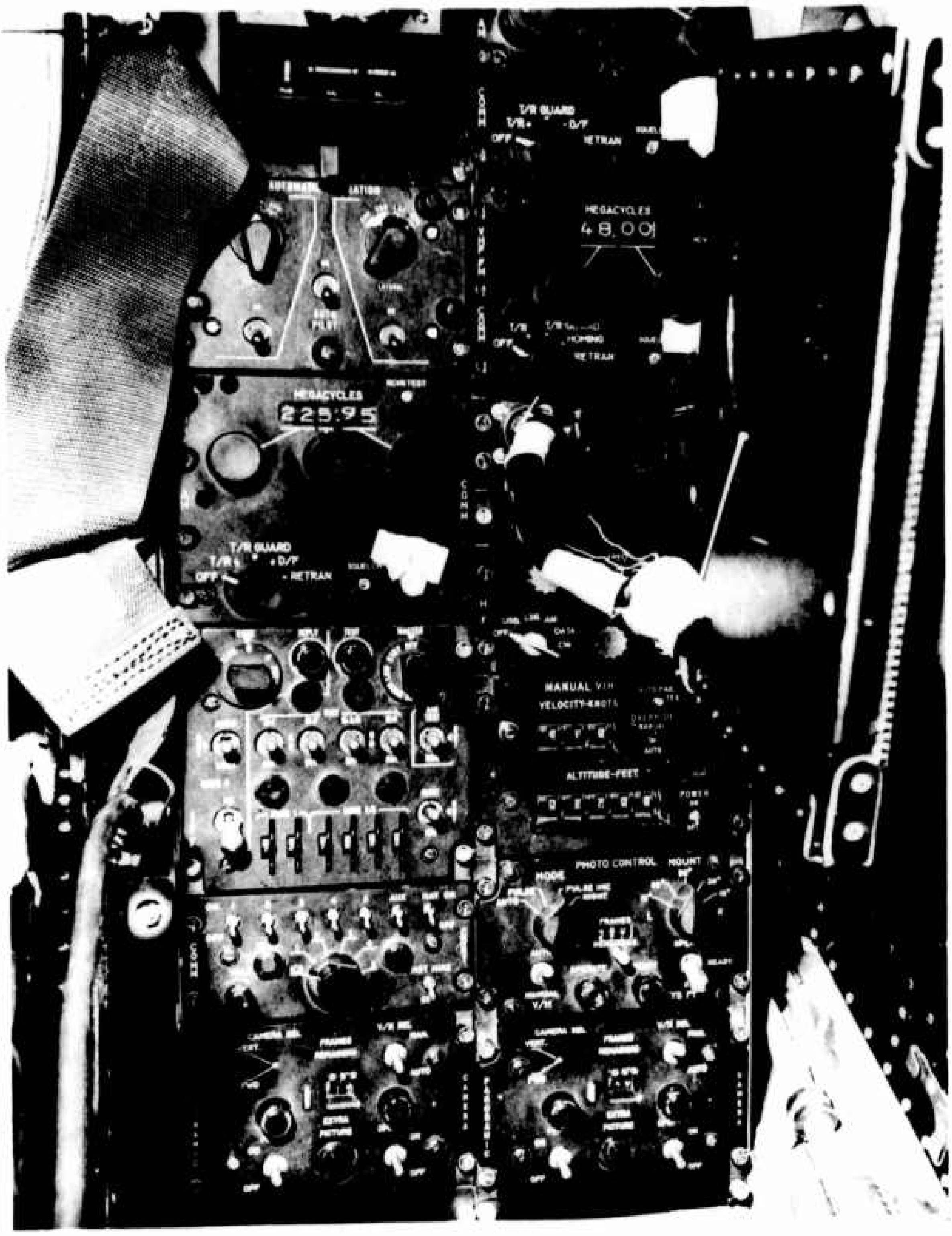


Photo 4. Production Console.

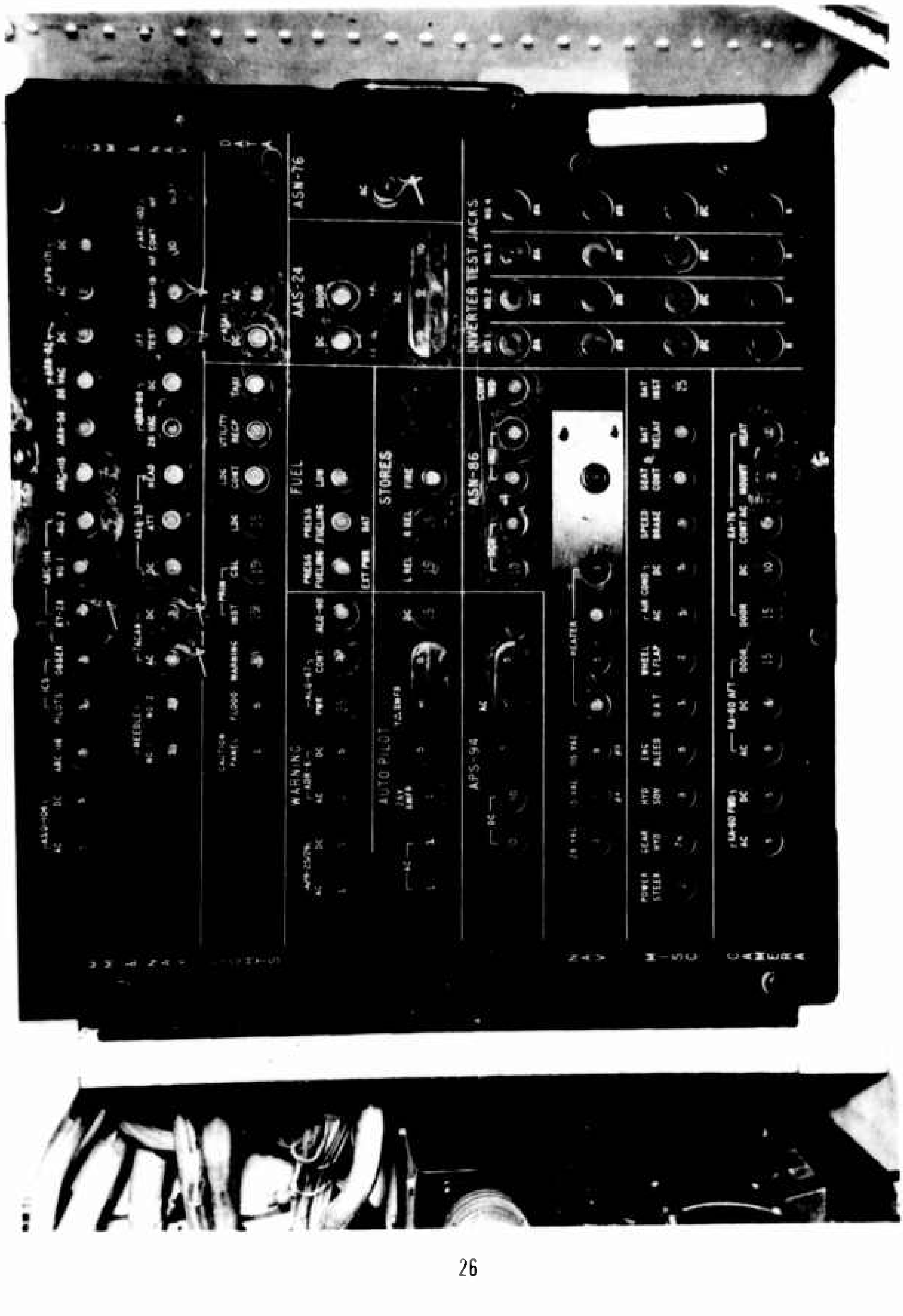


Photo 5. Circuit Breaker Panel.

CONCLUSIONS

GENERAL

45. The following conclusions were reached upon completion of the Army Preliminary Evaluation of the OV-1D airplane:

a. The airplane performance with both engines operating was satisfactory. Single engine performance was unsatisfactory due to poor rate of climb in the takeoff configuration.

b. The airplane's flying qualities are satisfactory and are assigned an overall PRS rating of 3.

DEFICIENCIES AND SHORTCOMINGS AFFECTING MISSION ACCOMPLISHMENT

46. Correction of the single engine climb performance deficiency is mandatory prior to acceptance of the airplane for short field operation.

47. Correction of the following shortcomings is desirable for improved operation and mission capabilities:

a. Low stall warning margins in the airplane landing configuration (para 22).

b. Excessive rudder pedal force during controlled single engine flight (para 34).

c. The lack of a cockpit accelerometer (para 35).

d. Asymmetric loading of three stores on the right wing and none on the left wing (assuming nonpurchase of the AN/ALQ-67 fuze jammer) (para 38).

e. Insufficient cockpit air conditioning during ground operation (para 39).

f. Lack of a speed brake warning light (para 42).

g. Inaccessibility of the navigational and autopilot circuit breakers (para 43).

h. Location of the INT panel and lack of switch guards (para 43).

RECOMMENDATIONS

48. The deficiency, correction of which is mandatory, should be corrected as soon as possible.

49. The shortcomings, correction of which is desirable, should be corrected on a high priority basis.

50. Further takeoff and landing performance testing should include operation from soft fields to determine the effects of the increased gross weight of the OV-1D (para 40).

51. Further testing should include landing in cross-winds above 15 knots to determine the effects of asymmetric stores loadings (para 38).

52. The technique of banking the airplane toward the operating engine to improve minimum, single-engine control speed should be included in the operator's manual (para 33).

53. Aerodynamic stall warnings should be improved or an artificial stall warning device should be incorporated (para 22).

54. A speed brake warning light should be installed in the cockpit (para 41).

55. The INT panel should be relocated and modified to incorporate switch guards (para 42).

APPENDIX I. REFERENCES

1. Letter, USAAVSCOM, AMSAV-R-F, subject: Test Directive No. 68-43 for the Army Preliminary Evaluation of the Preproduction OV-1D Aircraft, 23 January 1969, with Inclosure 1, "Test Directive, ATA Project No. 68-43, Pre-Production OV-1D, Army Preliminary Evaluation," 21 January 1969.

2. Test Plan, USAASTA Project No. 68-43, *Army Preliminary Evaluation of the Preproduction OV-1D Airplane*, June 1969.

3. Technical Manual, TM 55-1510-204-35-2, *DS, GS and Depot Maintenance Manual OV-1 Aircraft*, October 1968.

4. Specification, USAAMC, AMC-SS-2672 (Preliminary), *Detail Specification for (Pre-Production) Model OV-1D Airplane (Two Turbo-Prop Engines)*.

5. Technical Manual, TM 55-1510-204-10, *Operator's Manual OV-1 Aircraft*, October 1968.

6. Military specification, MIL-F-8785 (ASG)-2, *Flying Qualities of Piloted Airplanes*,

7. Grumman Report, XP134-10, *Installed Performance of the Lycoming T53-L-15 Engine as Estimated in the OV-1D Mohawk*, January 1968.

APPENDIX II. TEST DATA

FIGURE 1

LEVEL FLIGHT PERFORMANCE

OV-1D (PRE-PRODUCTION) USA S/N 67-18899

DUAL ENGINE

SYMBOL	AVG GROSS WEIGHT	AVG PRESSURE ALTITUDE	AVG OAT	EXTERNAL STORE CONFIGURATION
⊙	15500 LBS	5,000 FT	11.9°C	A
⊡	15700 LBS	10,000 FT	-0.2°C	A
▲	15700 LBS	15,000 FT	-9.1°C	A

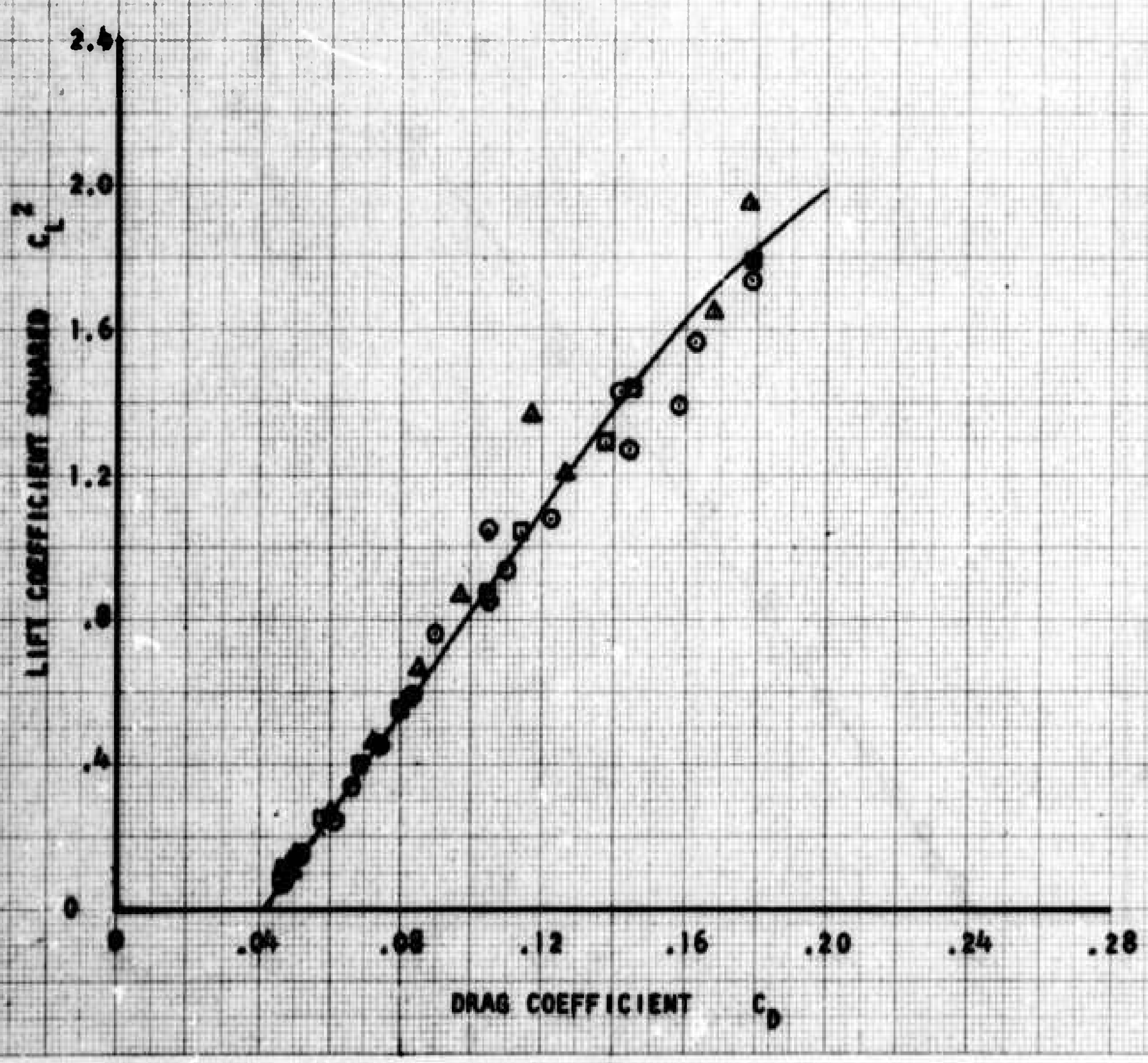


FIGURE 2
LEVEL FLIGHT PERFORMANCE
OV-10 (PRE-PRODUCTION) USA S/N 67-18899
DUAL ENGINE

SYMBOL	AVG GROSS WEIGHT	AVG PRESSURE ALTITUDE	AVG OAT	EXTERNAL STORE CONFIGURATION
⊙	16000 LBS	5,000 FT	5.4°C	B

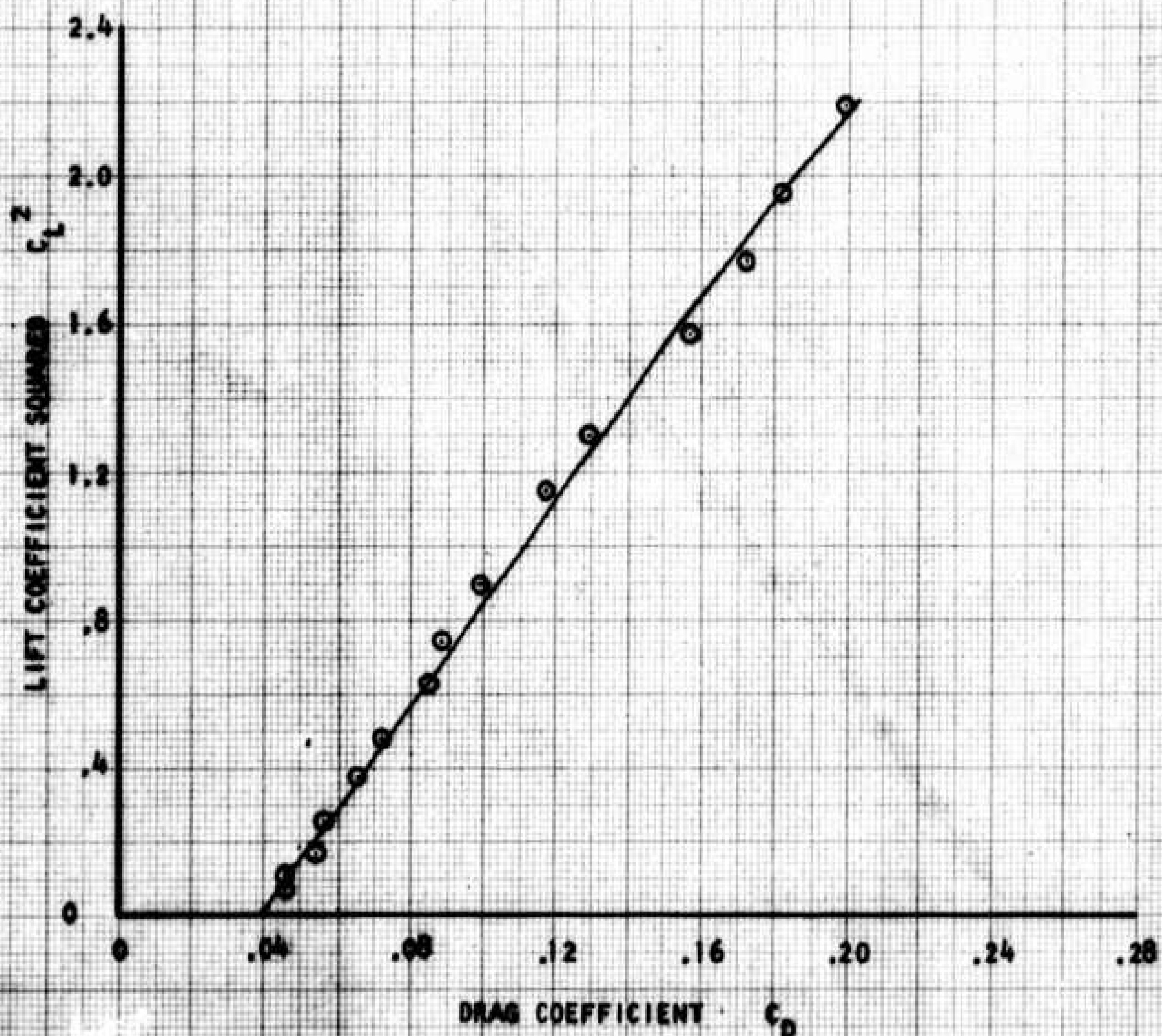


FIGURE 3
LEVEL FLIGHT PERFORMANCE
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
DUAL ENGINE

AVG. GROSS WEIGHT	AVG. PRESSURE ALTITUDE	AVG. C.G.	STORE CONFIG.	AVG OAT
15900 LBS	5000 FT	26.0 %MAC	C	2.6°C

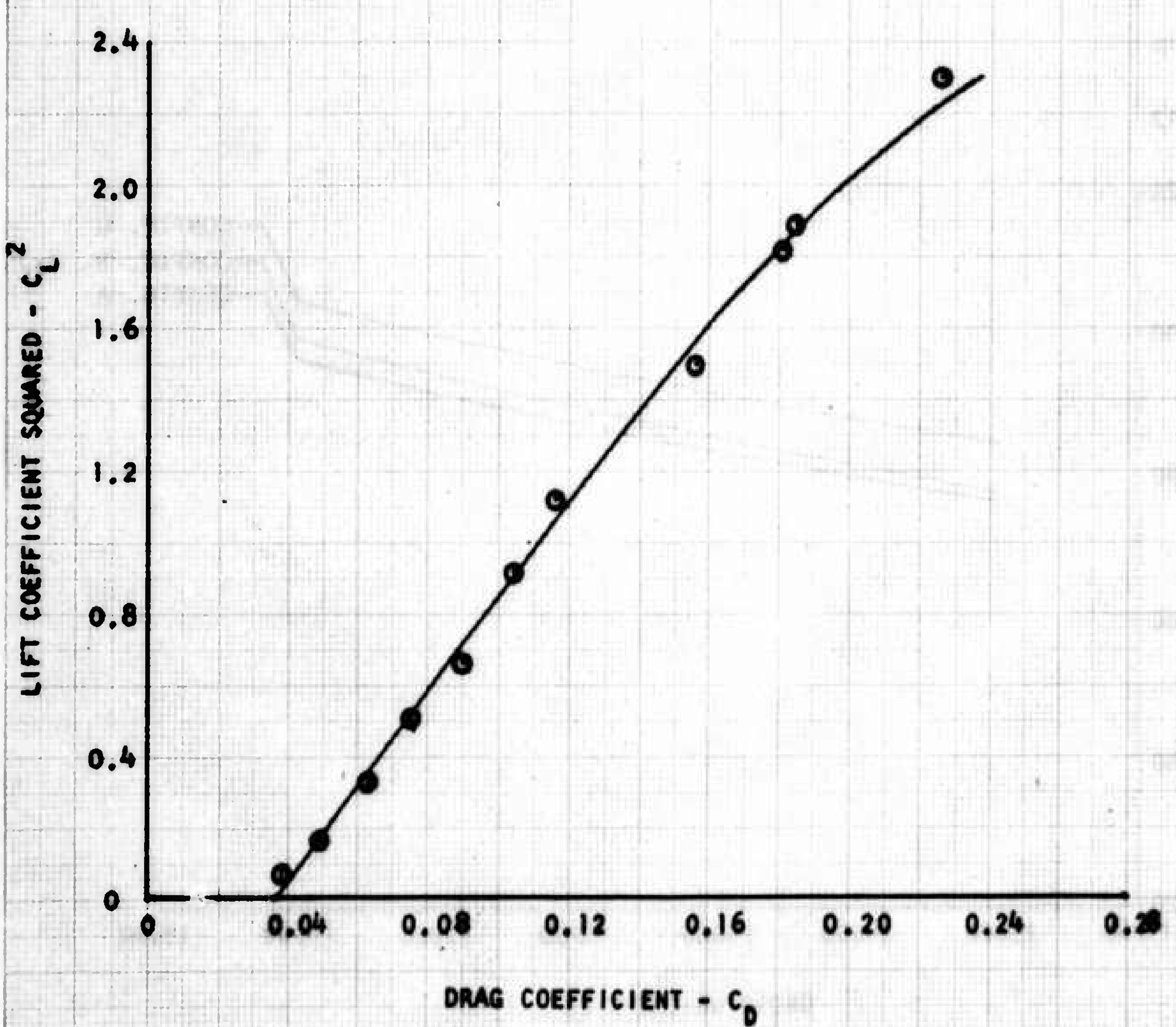


FIGURE 4
LEVEL FLIGHT RANGE SUMMARY
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
STANDARD DAY

SEA LEVEL MID C.G. DUAL T53-L-15 SPEC ENGINES (ref 7, app I)

NOTE: CURVES DERIVED FROM FIGURES 1 THROUGH 3.

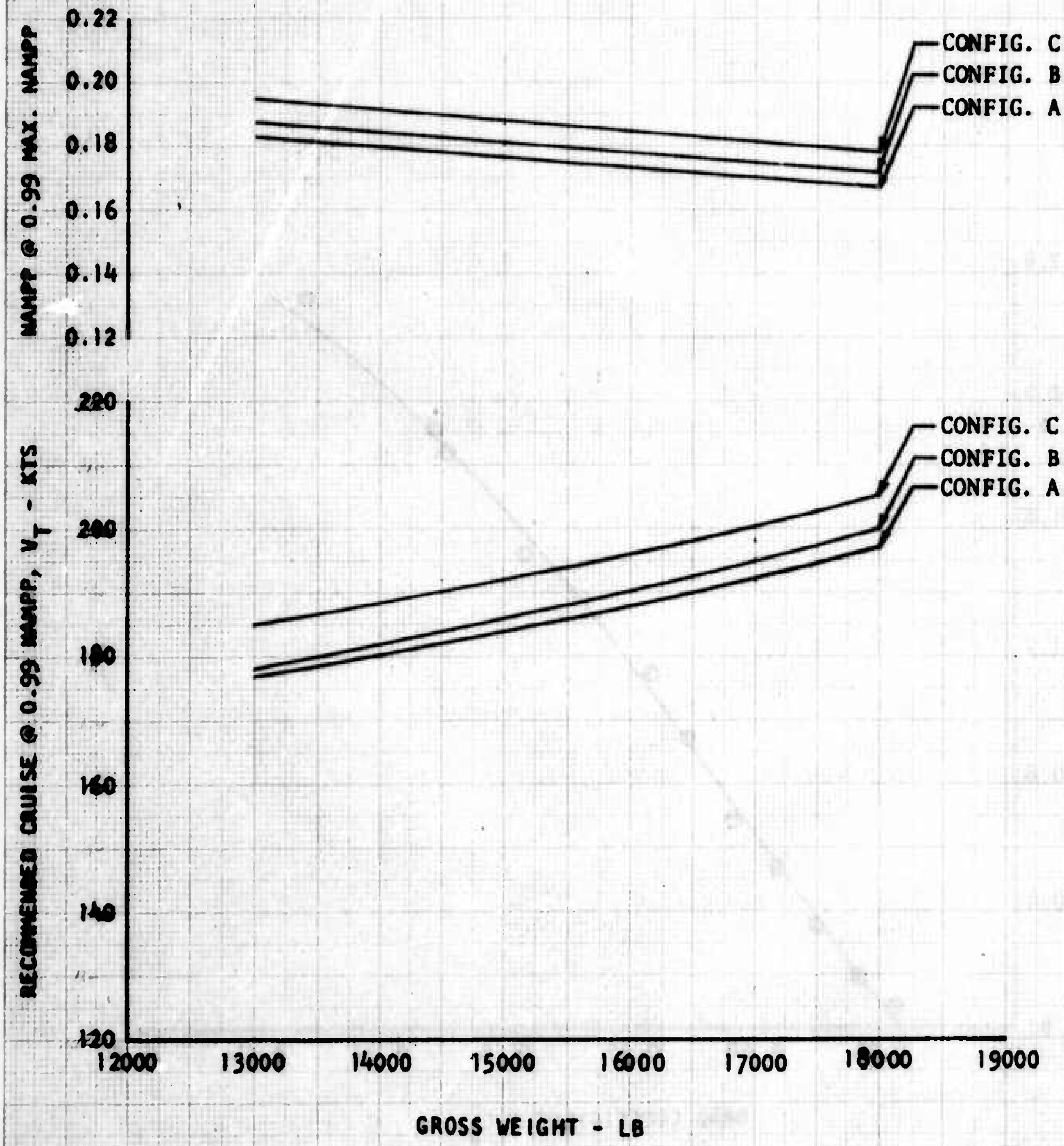


FIGURE 9.
LEVEL FLIGHT RANGE SUMMARY
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
STANDARD DAY

5000 FT MID C.G. DUAL T53-L-15 SPEC ENGINES
(ref 7, app I)

NOTE: CURVES DERIVED FROM FIGURES 1 THROUGH 3.

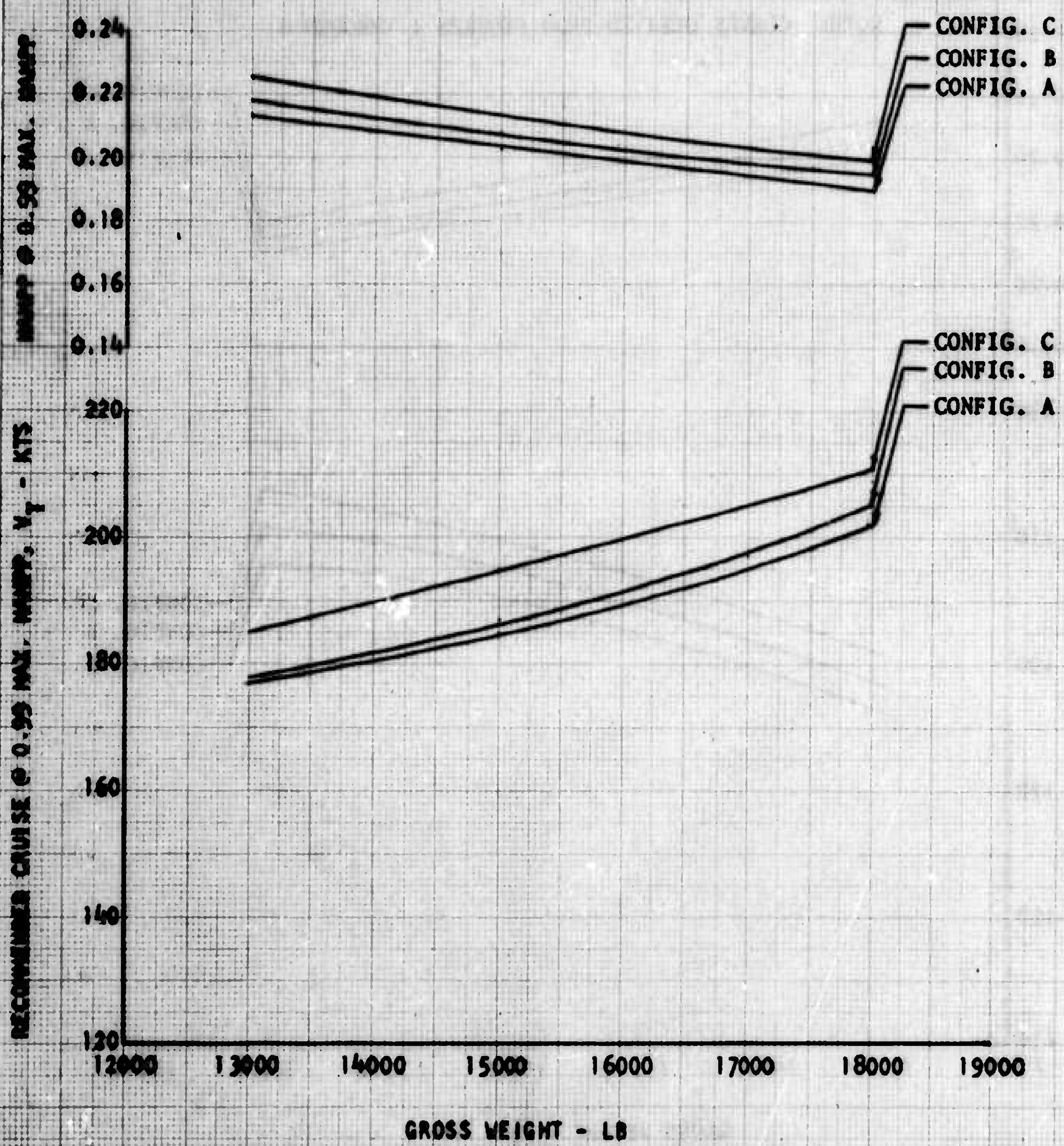


FIGURE 6.
LEVEL FLIGHT RANGE SUMMARY
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
STANDARD DAY

10000 FT MID C.G. DUAL T53-L-15 SPEC ENGINES (ref 7, app I)

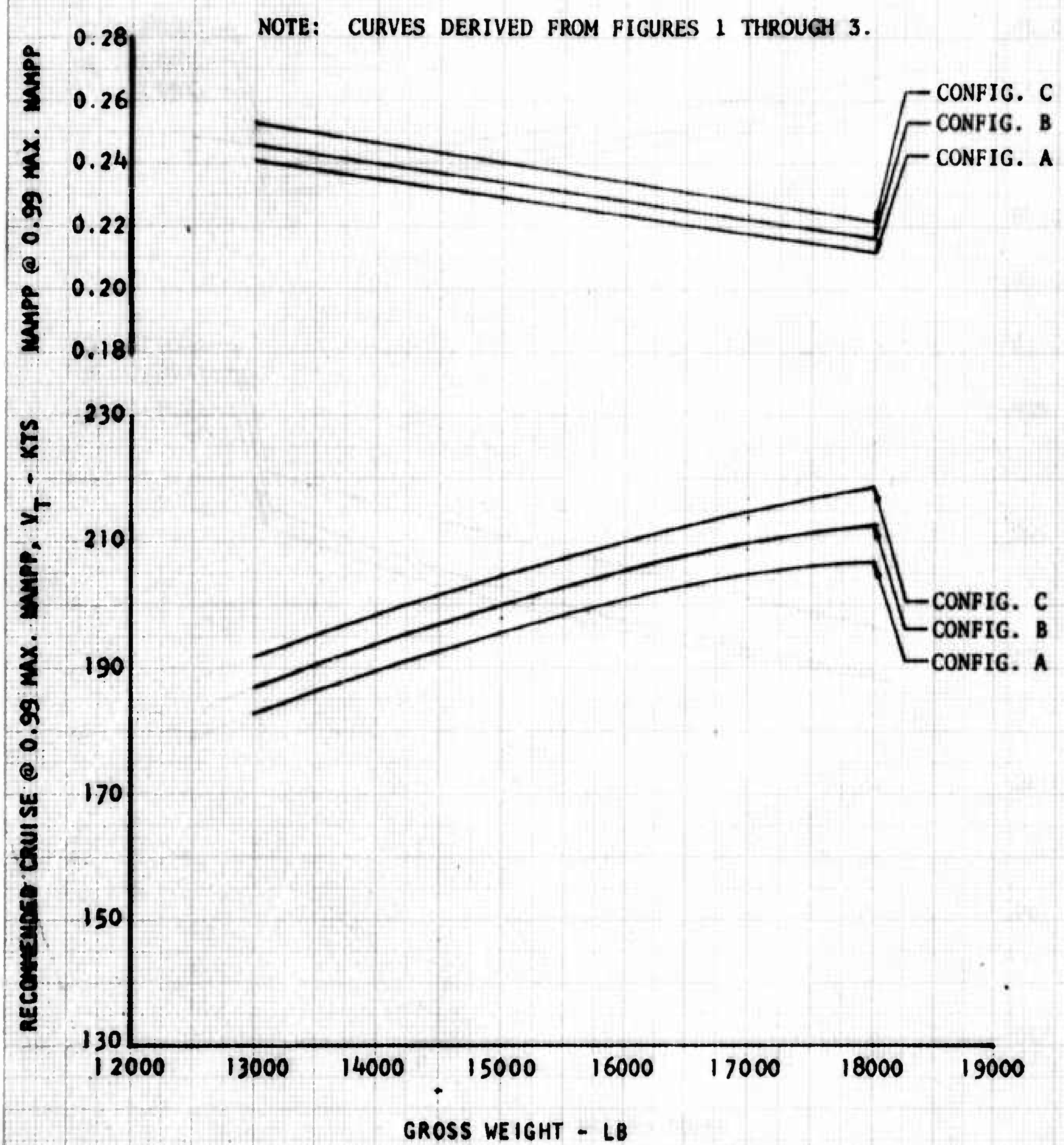


FIGURE 7

SPEED CAPABILITY

OV-1D (PRE-PRODUCTION) USA S/N 67-18899

CONFIGURATION A

STANDARD DAY

MID C.G.

NOTE:

1. CURVES DERIVED FROM FIGURE 1.
2. MRP BASED ON DUAL T53-L-15 SPEC. ENGINE (ref 7, app I)

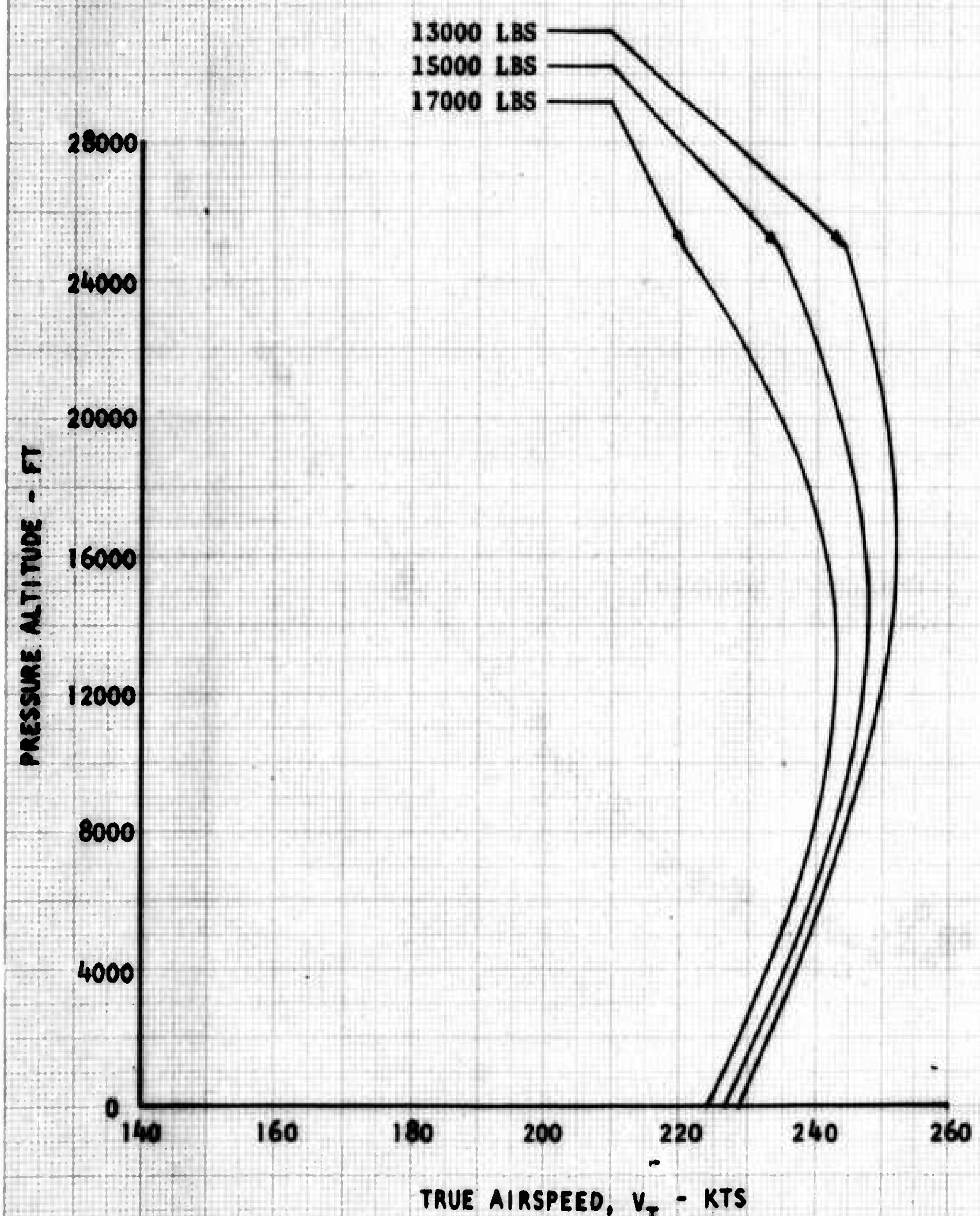


FIGURE 8
LEVEL FLIGHT PERFORMANCE
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
DUAL ENGINES
STANDARD WEIGHT = 16,000 LB

SYM	AVG. GROSS WEIGHT	AVG. PRESSURE ALTITUDE	AVG. C.G.	STORE CONFIG.	AVG OAT
⊙	15500 LBS	5000 FT	25.8 %MAC	A	11.9°C
▲	15700 LBS	10000 FT	25.8 %MAC	A	-0.2°C
⊡	15700 LBS	15000 FT	25.8 %MAC	A	-9.1°C

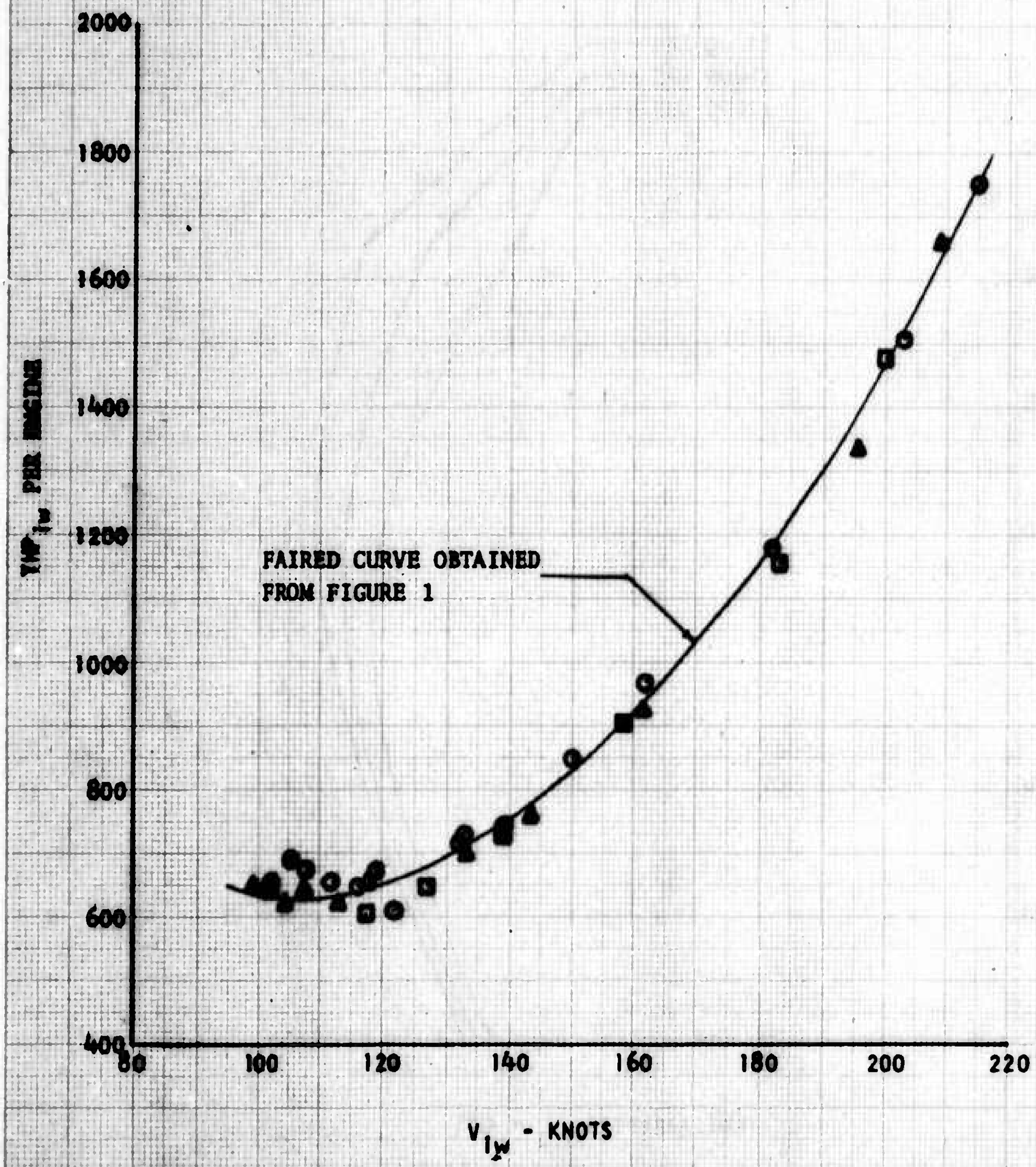


FIGURE No. 9
LEVEL FLIGHT PERFORMANCE
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
DUAL ENGINE
STANDARD WEIGHT = 15,700 LB

AVG. GROSS WEIGHT	AVG. PRESSURE ALTITUDE	AVG. C.G.	STORE CONFIG.	AVG OAT
16000 LBS	5000 FT	26.0 %MAC	B	5.4°C

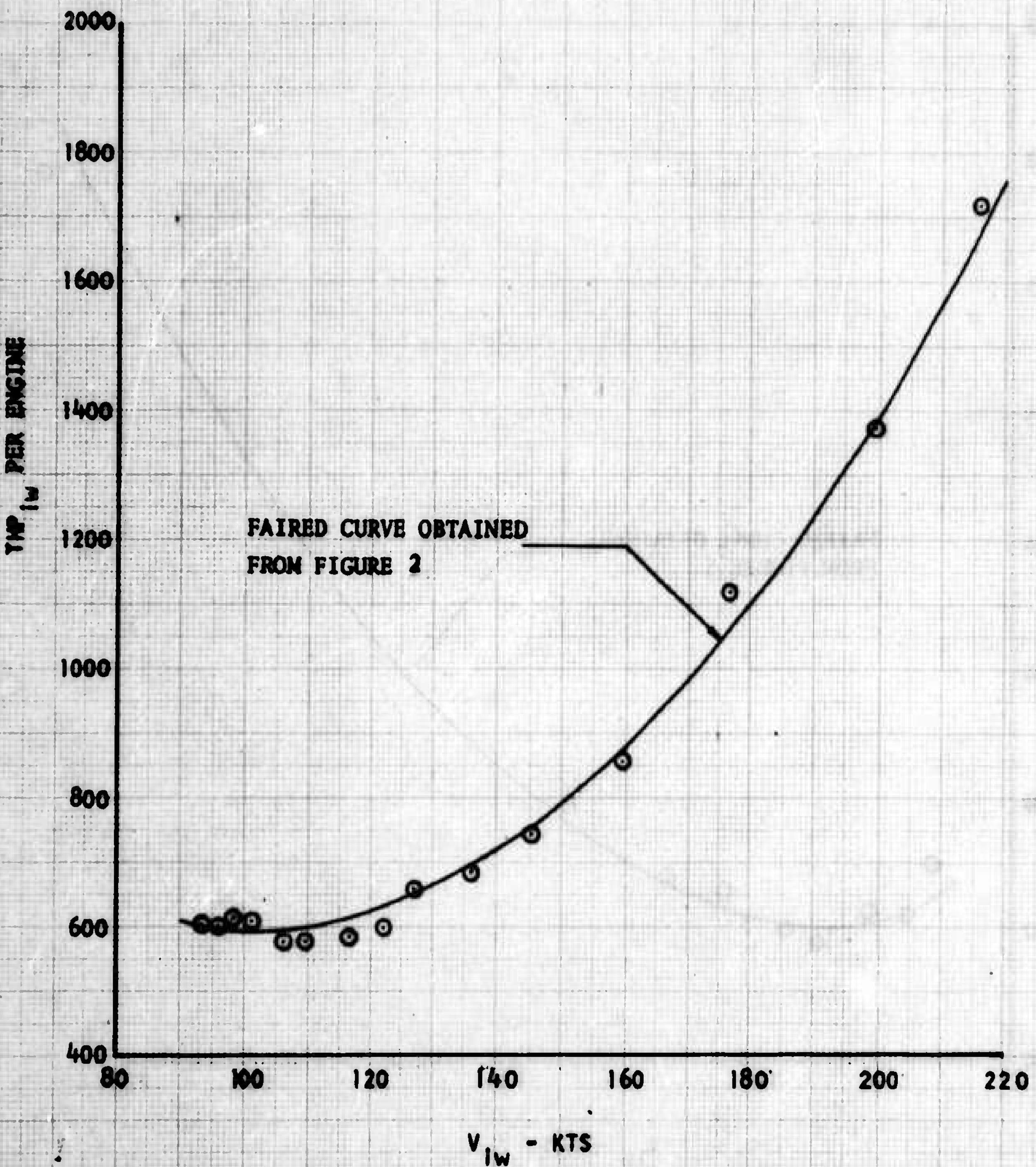
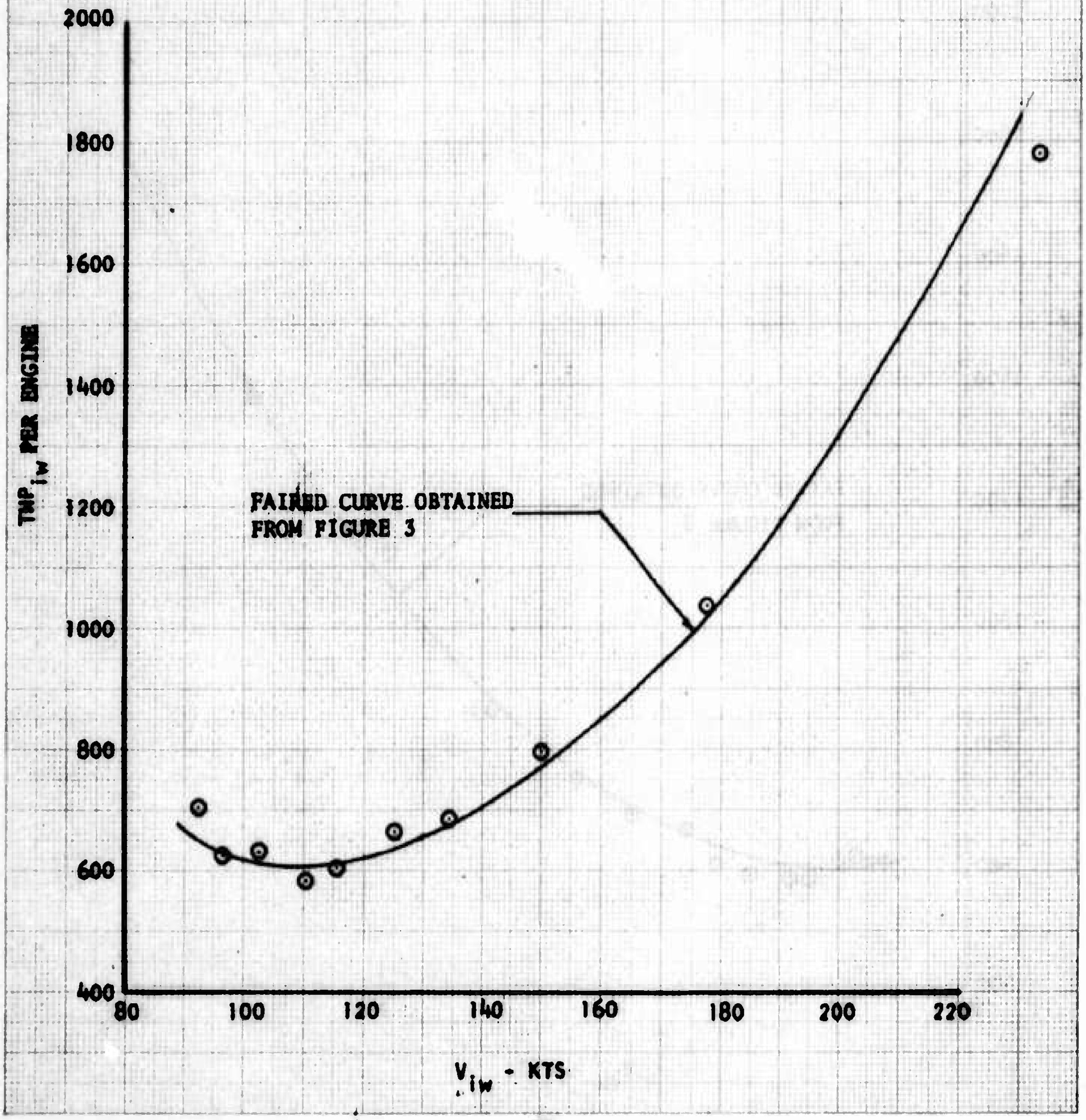


FIGURE No. 10
LEVEL FLIGHT PERFORMANCE
OV-10 (PRE-PRODUCTION) USA S/N 67-18899
DUAL ENGINE
STANDARD WEIGHT = 16,000 LB

AVG. GROSS WEIGHT	AVG. PRESSURE ALTITUDE	AVG. C.G.	STORE CONFIG.	AVG OAT
15900 LBS	5000 FT	26.0 %MAC	C	2.6°C



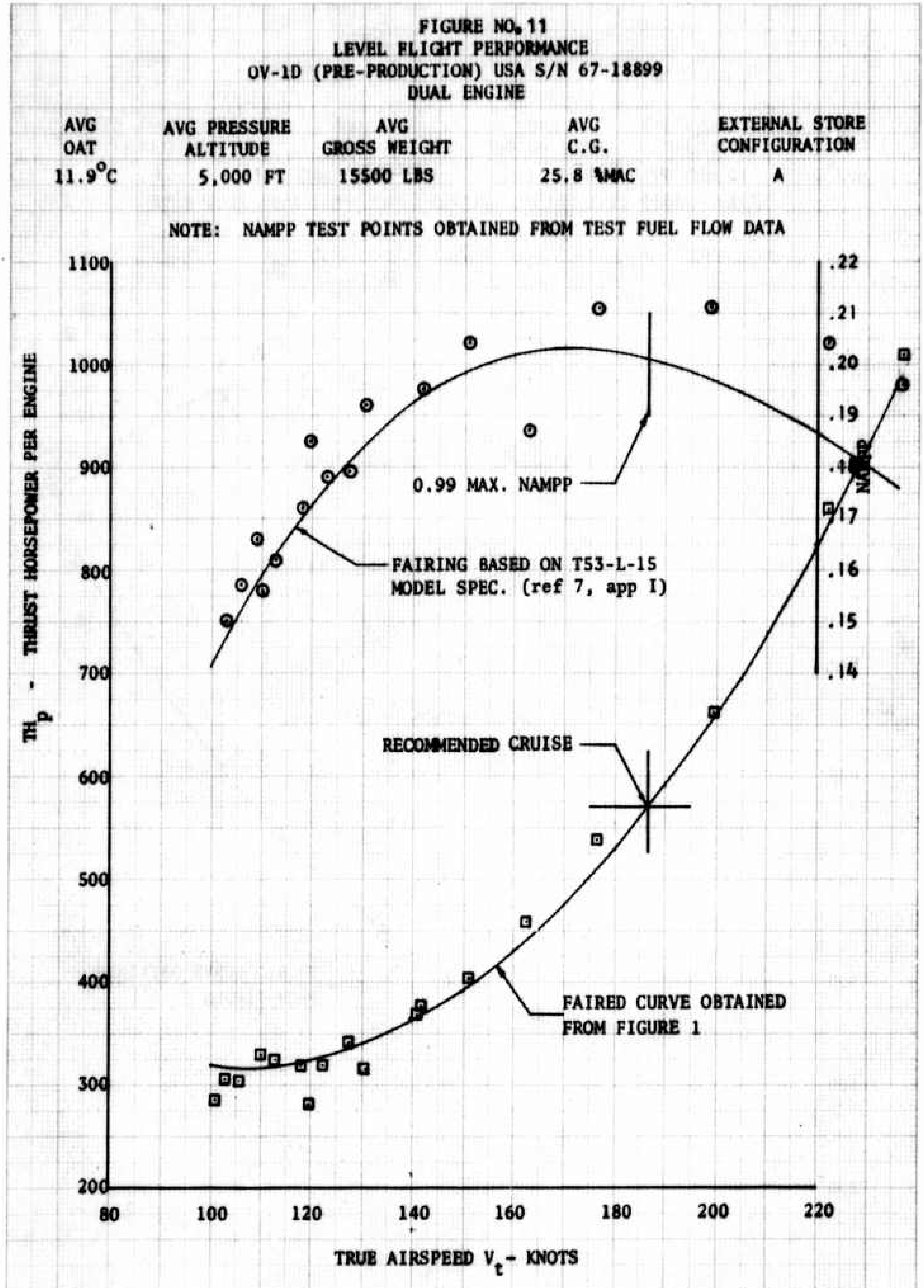
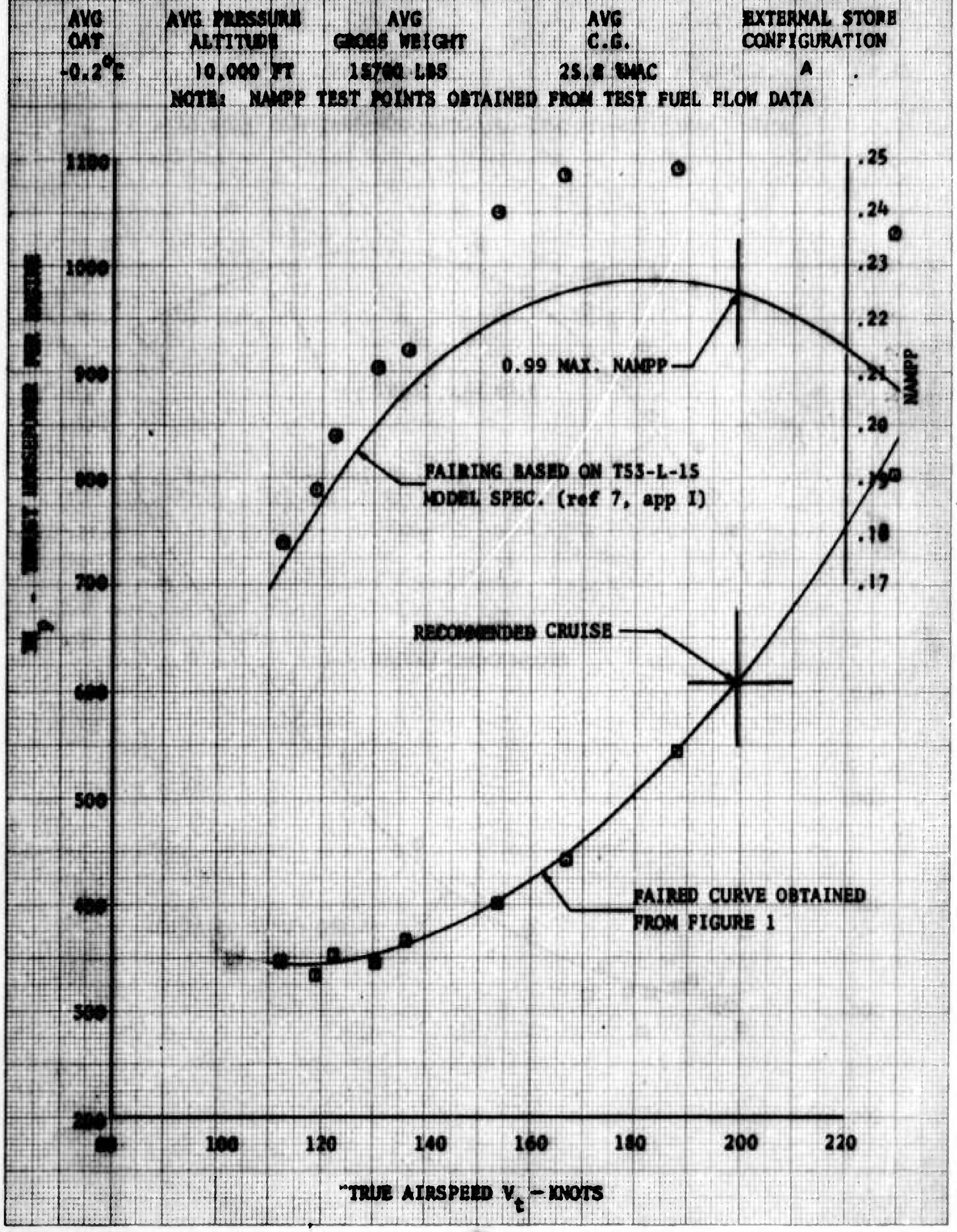


FIGURE NO. 11
LEVEL FLIGHT PERFORMANCE
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
DUAL ENGINE
AVG OAT 11.9°C
AVG PRESSURE ALTITUDE 5,000 FT
AVG GROSS WEIGHT 15500 LBS
AVG C.G. 25.8 %MAC
EXTERNAL STORE CONFIGURATION A
NOTE: NAMPP TEST POINTS OBTAINED FROM TEST FUEL FLOW DATA
0.99 MAX. NAMPP
FAIRING BASED ON T53-L-15 MODEL SPEC. (ref 7, app I)
RECOMMENDED CRUISE
FAIRED CURVE OBTAINED FROM FIGURE 1
THp - THRUST HORSEPOWER PER ENGINE
NAMPP
TRUE AIRSPEED Vt - KNOTS
1100
1000
900
800
700
600
500
400
300
200
80
100
120
140
160
180
200
220
.22
.21
.20
.19
.17
.16
.15
.14

FIGURE NO. 12
LEVEL FLIGHT PERFORMANCE
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
DUAL ENGINE



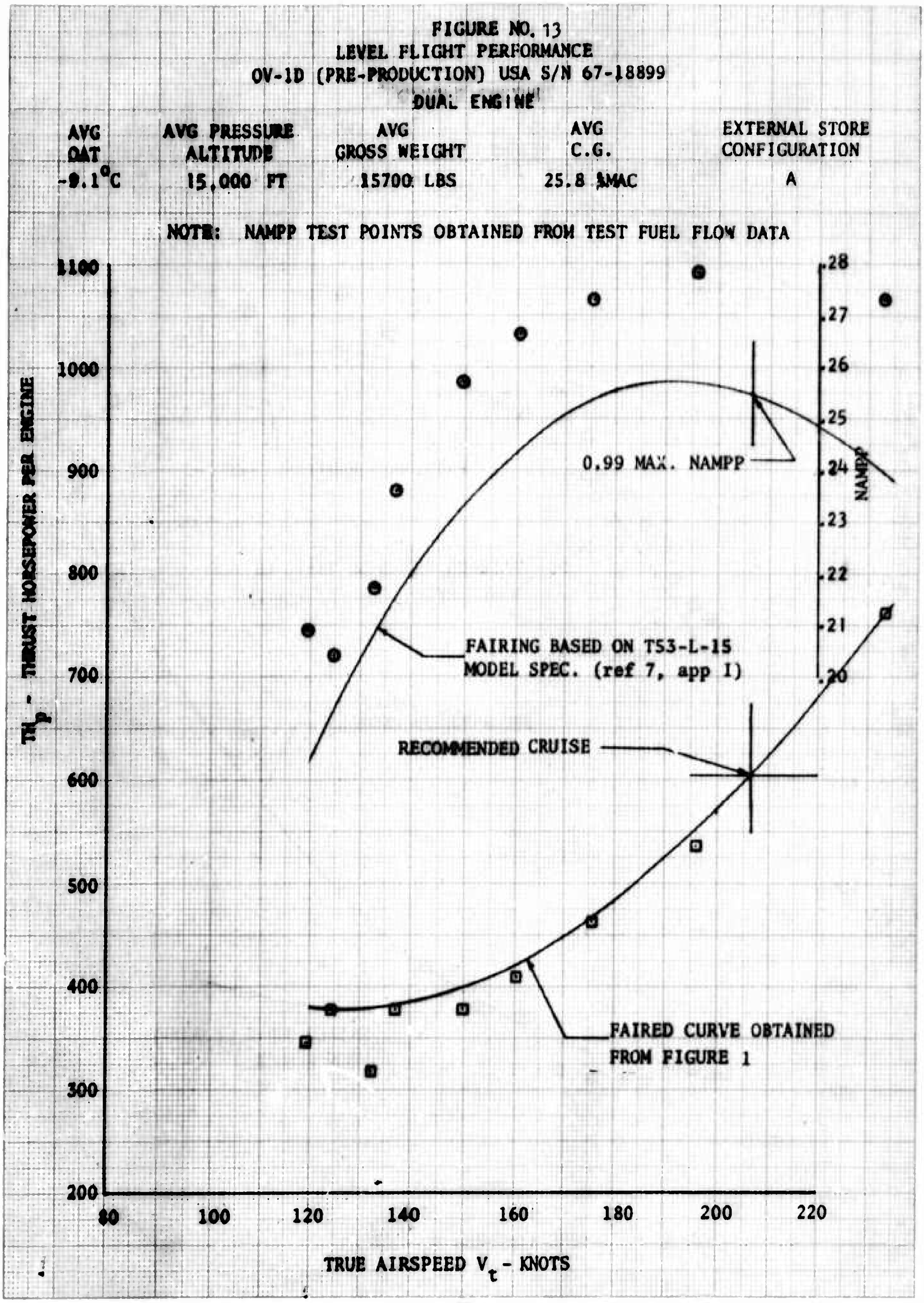


FIGURE NO. 13
LEVEL FLIGHT PERFORMANCE
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
DUAL ENGINE
AVG OAT
-9.1°C
AVG PRESSURE ALTITUDE
15,000 FT
AVG GROSS WEIGHT
15700 LBS
AVG C.G.
25.8 %MAC
EXTERNAL STORE CONFIGURATION
A
NOTE: NAMPP TEST POINTS OBTAINED FROM TEST FUEL FLOW DATA
0.99 MAX. NAMPP
FAIRING BASED ON T53-L-15 MODEL SPEC. (ref 7, app I)
RECOMMENDED CRUISE
FAIRED CURVE OBTAINED FROM FIGURE 1
THP - THRUST HORSEPOWER PER ENGINE
NAMPP
TRUE AIRSPEED Vt - KNOTS
1100
1000
900
800
700
600
500
400
300
200
80
100
120
140
160
180
200
220
.28
.27
.26
.25
.24
.23
.22
.21
.20

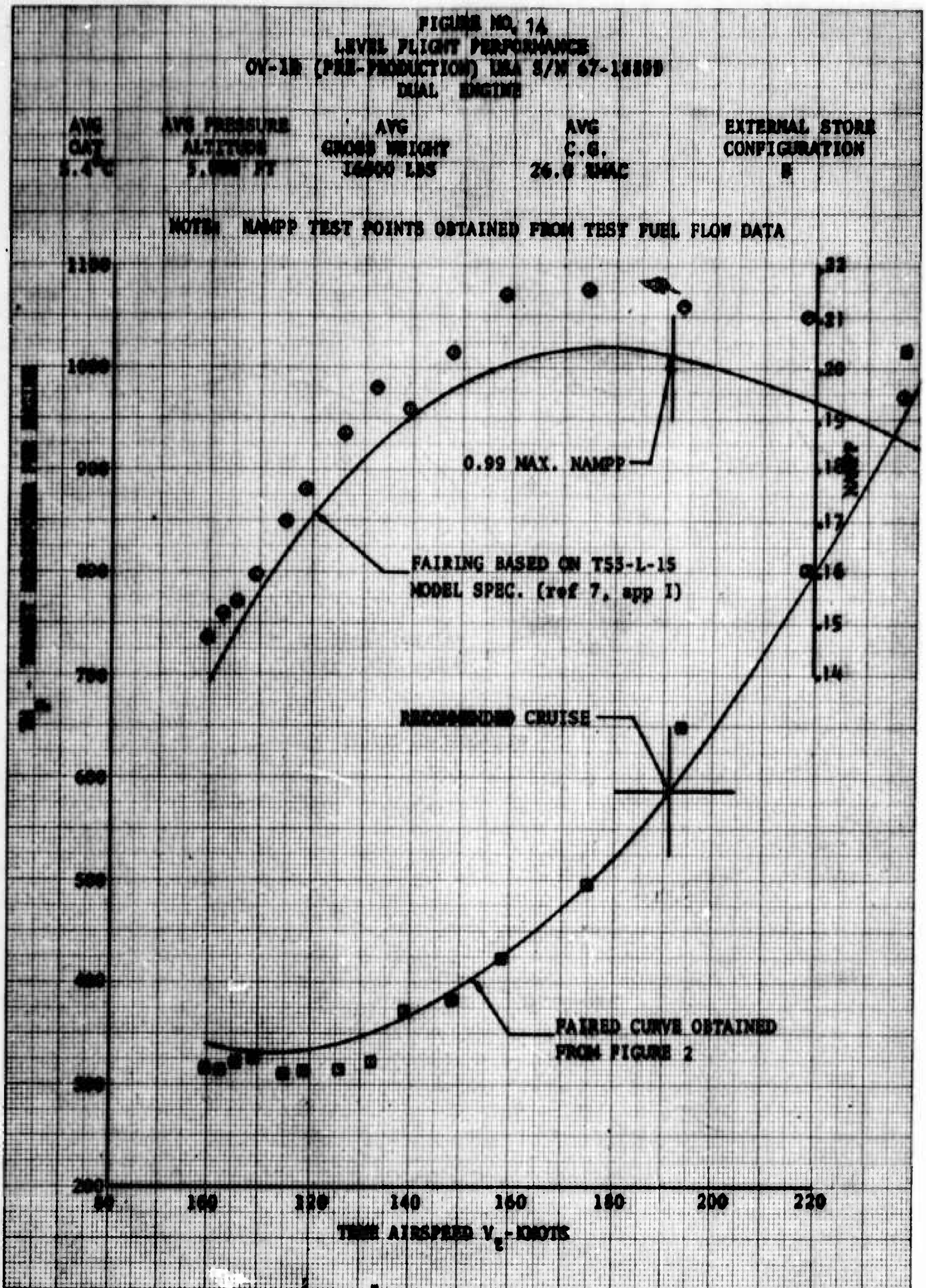


FIGURE NO. 14
LEVEL FLIGHT PERFORMANCE
DUAL ENGINE
AVG PRESSURE ALTITUDE
AVG GROSS WEIGHT
AVG C.G.
EXTERNAL STORE CONFIGURATION
NOTE: NAMPP TEST POINTS OBTAINED FROM TEST FUEL FLOW DATA
0.99 MAX. NAMPP
FAIRING BASED ON T53-L-15 MODEL SPEC. (ref 7, app I)
RECOMMENDED CRUISE
FAIRED CURVE OBTAINED FROM FIGURE 2
1100
1000
900
800
700
600
500
400
300
200
.22
.21
.20
.19
.17
.16
.15
.14
80
100
120
140
160
180
200
220
TRUE AIRSPEED

FIGURE NO. 15
LEVEL FLIGHT PERFORMANCE
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
DUAL ENGINE

AVG OAT	AVG PRESSURE ALTITUDE	AVG GROSS WEIGHT	AVG C.G.	EXTERNAL STORE CONFIGURATION
2.6°C	5000 FT	15900 LBS	26.0 %MAC	C

NOTE: NAMPP TEST POINTS OBTAINED FROM TEST FUEL FLOW DATA

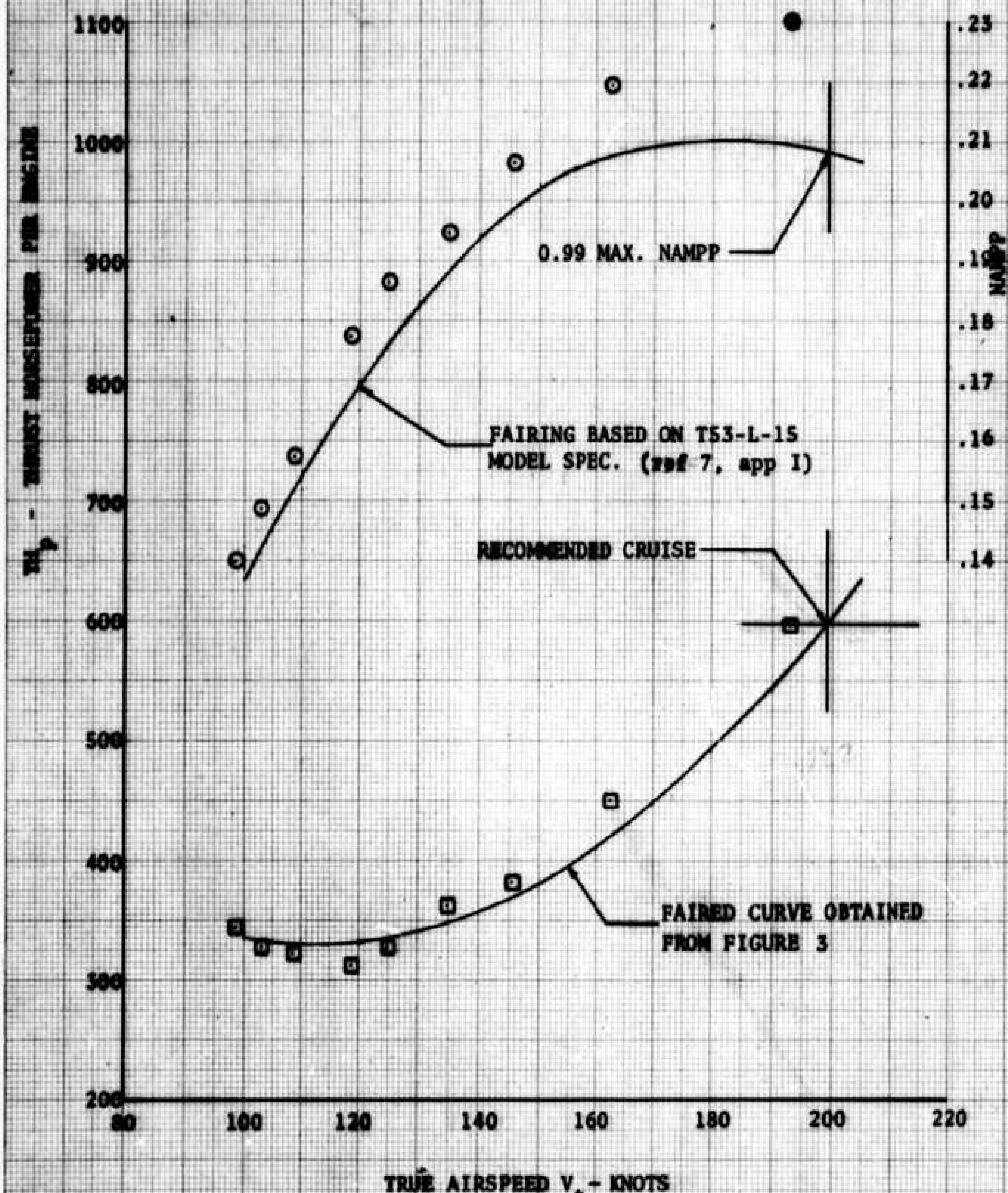
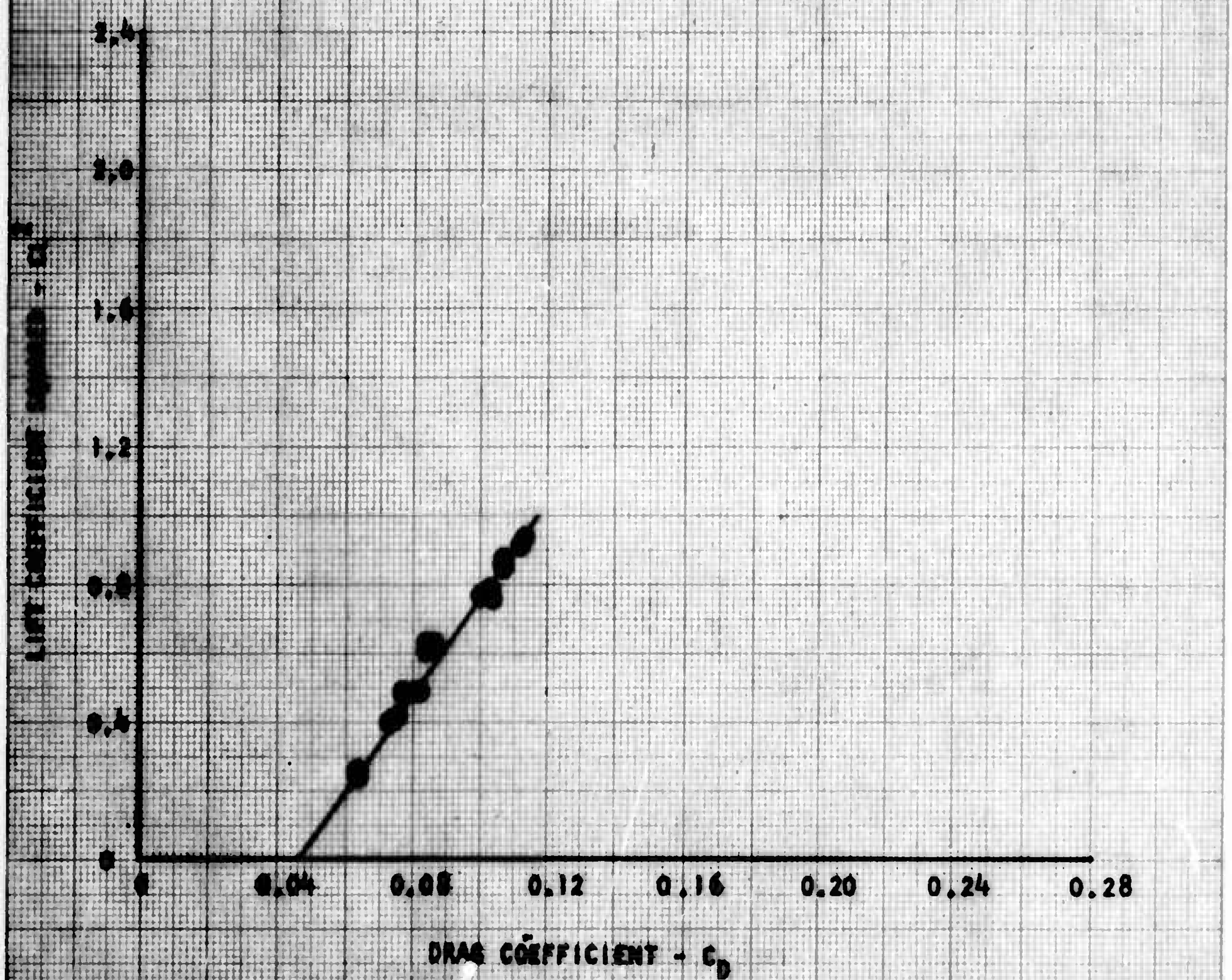


FIGURE No. 16
LEVEL FLIGHT PERFORMANCE
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
SINGLE ENGINE

AVG. GROSS WEIGHT	AVG. PRESSURE ALTITUDE	AVG. C.G.	STORE CONFIG.	AVG OAT
14500 LBS	5000 FT	25.2 %MAC	A	-2.1°C



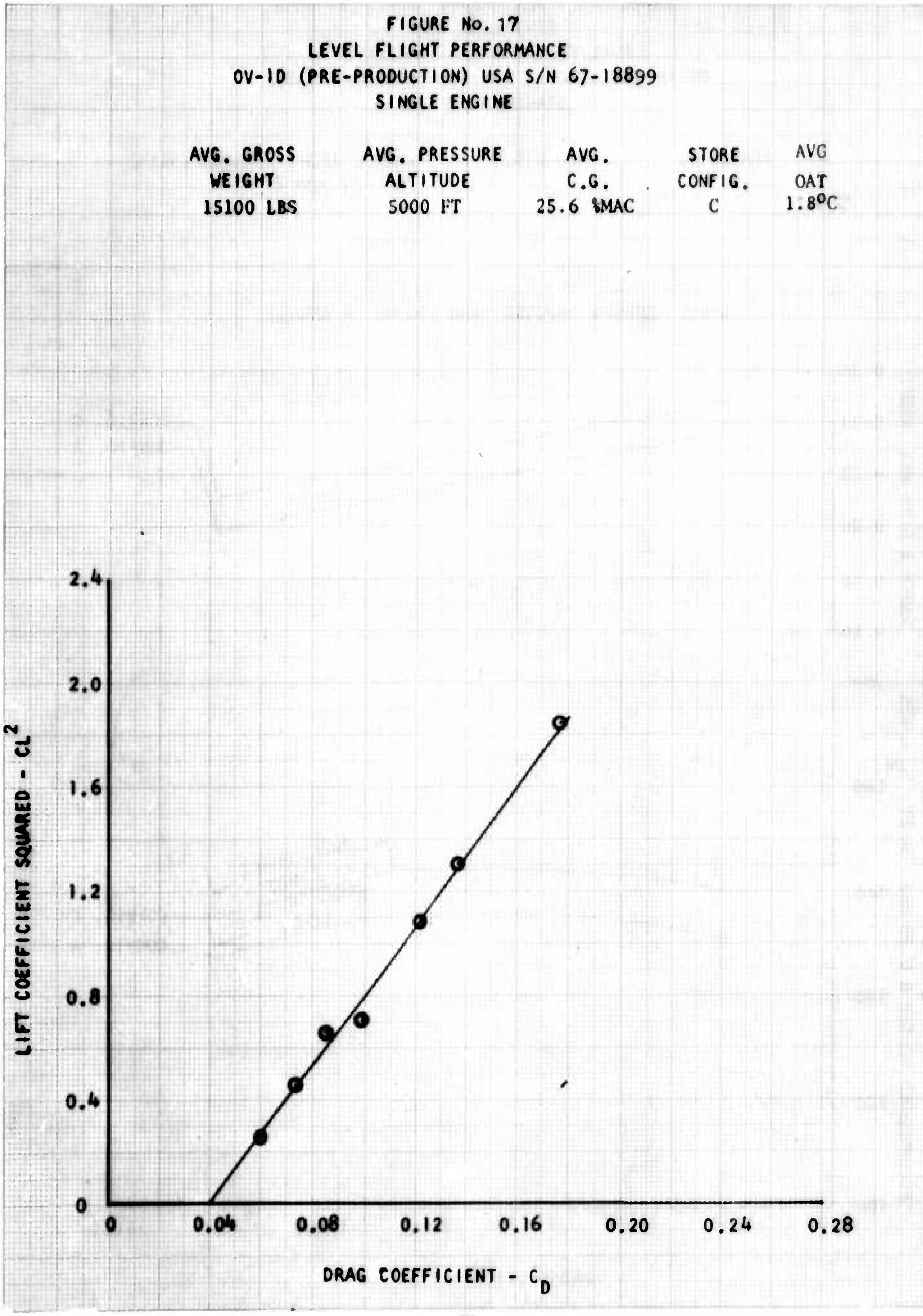


FIGURE No. 17
LEVEL FLIGHT PERFORMANCE
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
SINGLE ENGINE
AVG. GROSS WEIGHT 15100 LBS
AVG. PRESSURE ALTITUDE 5000 FT
AVG. C.G. 25.6 %MAC
STORE CONFIG. C
AVG OAT 1.8°C
LIFT COEFFICIENT SQUARED - CL²
0
0.4
0.8
1.2
1.6
2.0
2.4
0
0.04
0.08
0.12
0.16
0.20
0.24
0.28
DRAG COEFFICIENT - CD

FIGURE No. 18
LEVEL FLIGHT RANGE SUMMARY
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
STANDARD DAY

SEA LEVEL MID C.G. SINGLE T53-L-15 SPEC ENGINE (ref 7, app I)

NOTE: CURVES DERIVED FROM FIGURE 16 AND 17

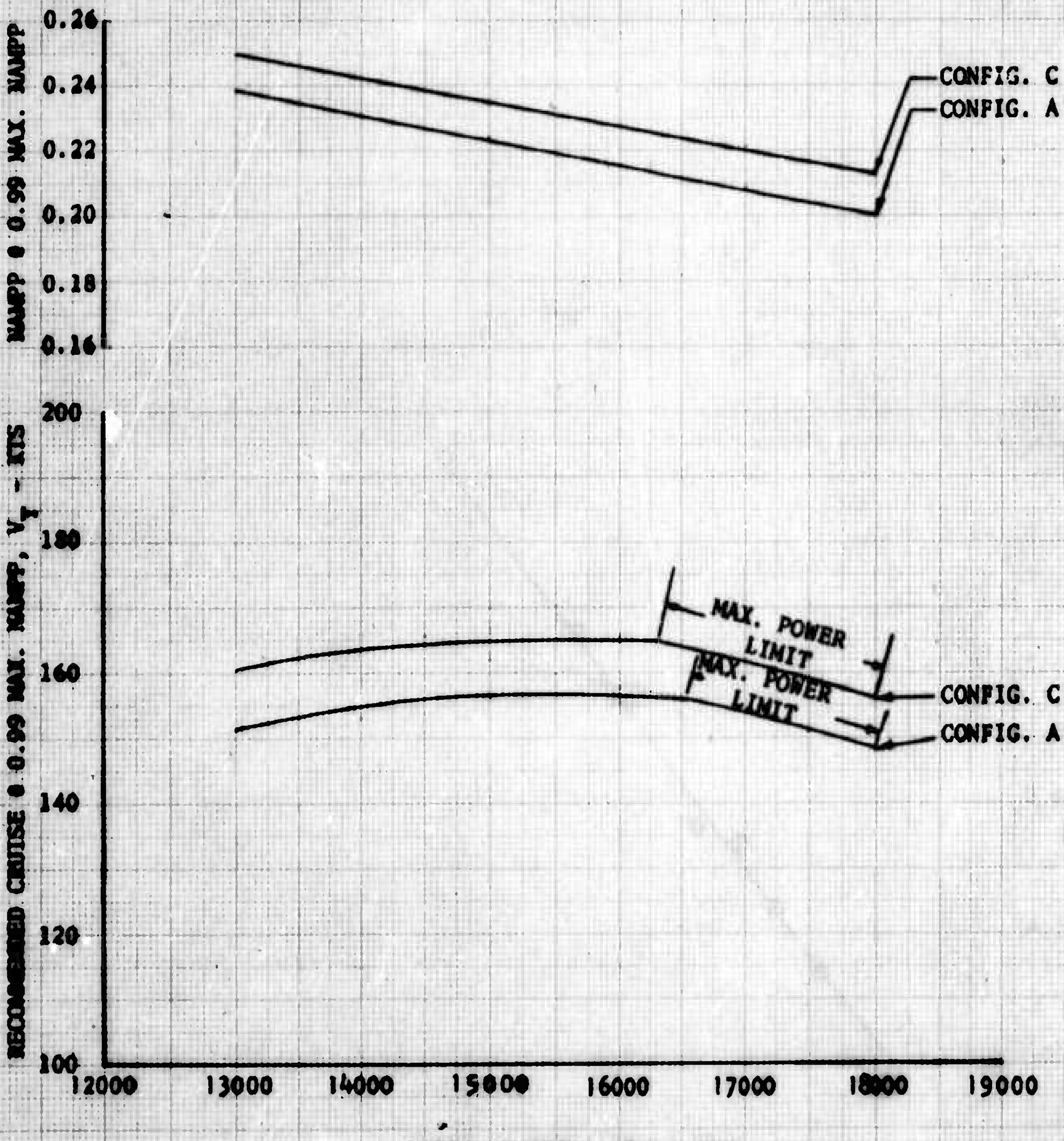
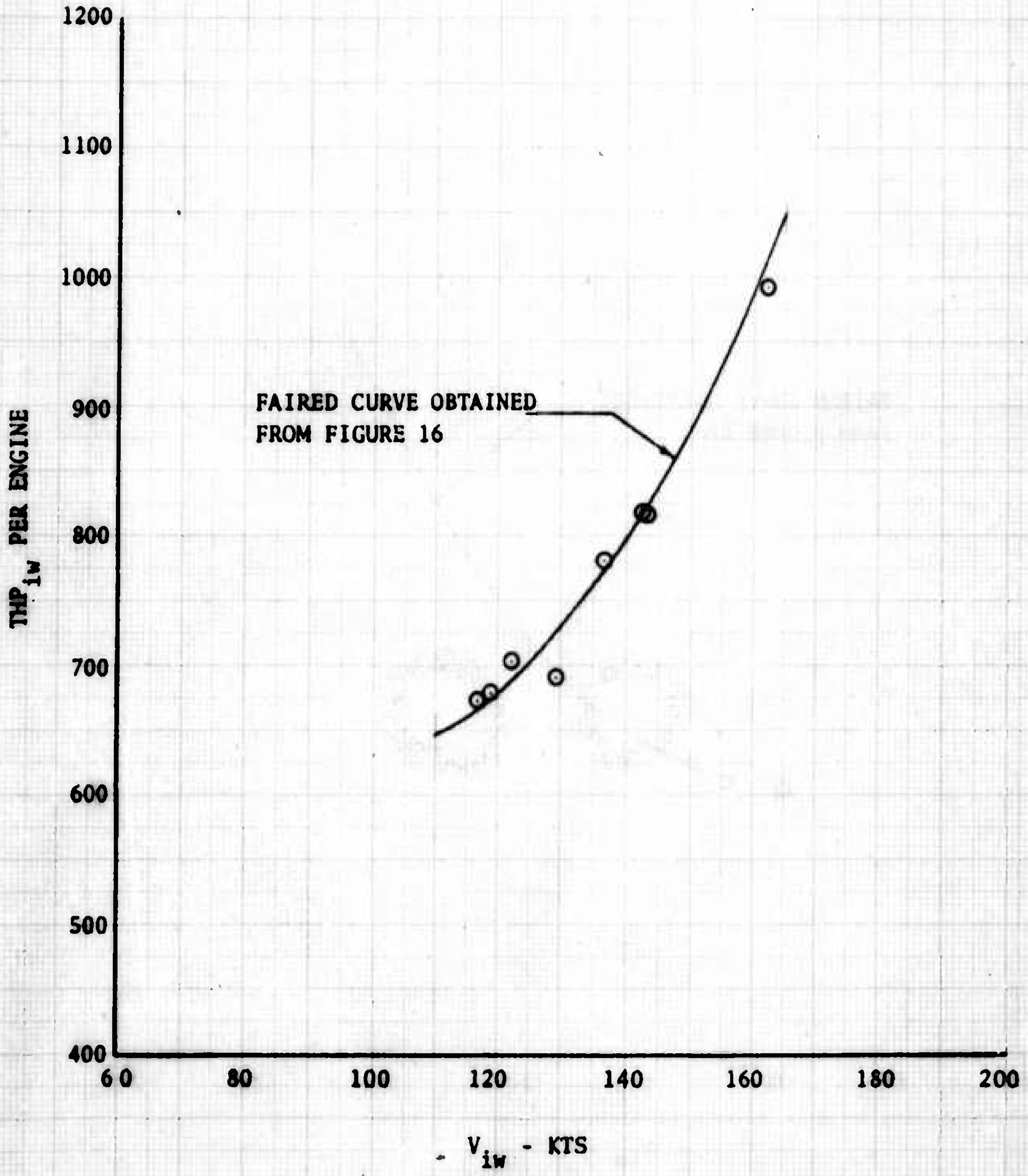


FIGURE No. 19
LEVEL FLIGHT PERFORMANCE
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
SINGLE ENGINE
STANDARD WEIGHT = 16,000 LB

AVG. GROSS WEIGHT	AVG. PRESSURE ALTITUDE	AVG. C.G.	STORE CONFIG.	AVG OAT
14500 LBS	5000 FT	25.2 %MAC	A	-2.1°C



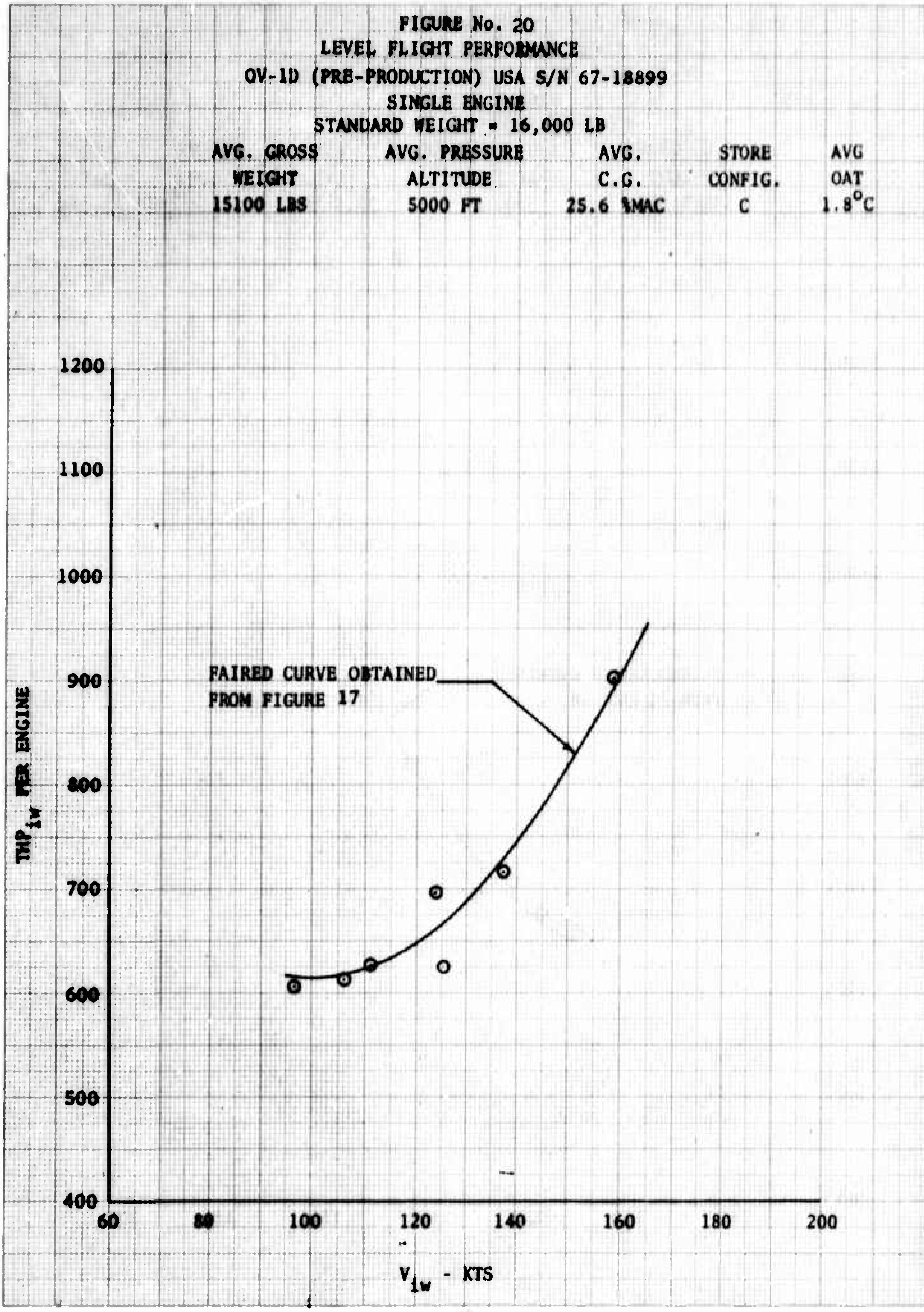


FIGURE No. 20
LEVEL FLIGHT PERFORMANCE
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
SINGLE ENGINE
STANDARD WEIGHT = 16,000 LB
AVG. GROSS WEIGHT 15100 LBS
AVG. PRESSURE ALTITUDE 5000 FT
AVG. C.G. 25.6 %MAC
STORE CONFIG. C
AVG OAT 1.8°C
FAIRED CURVE OBTAINED FROM FIGURE 17
THP$_{iw}$ PER ENGINE
1200
1100
1000
900
800
700
600
500
400
60
80
100
120
140
160
180
200
V$_{iw}$ - KTS

FIGURE No. 21
LEVEL FLIGHT PERFORMANCE
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
SINGLE ENGINE

AVG OAT	AVG. GROSS WEIGHT	AVG. PRESSURE ALTITUDE	AVG. C.G.	STORE CONFIG.
-2.1°C	14500 LBS	5000 FT	25.2 %MAC	A

NOTE: NAMPP TEST POINTS OBTAINED FROM TEST FUEL FLOW DATA

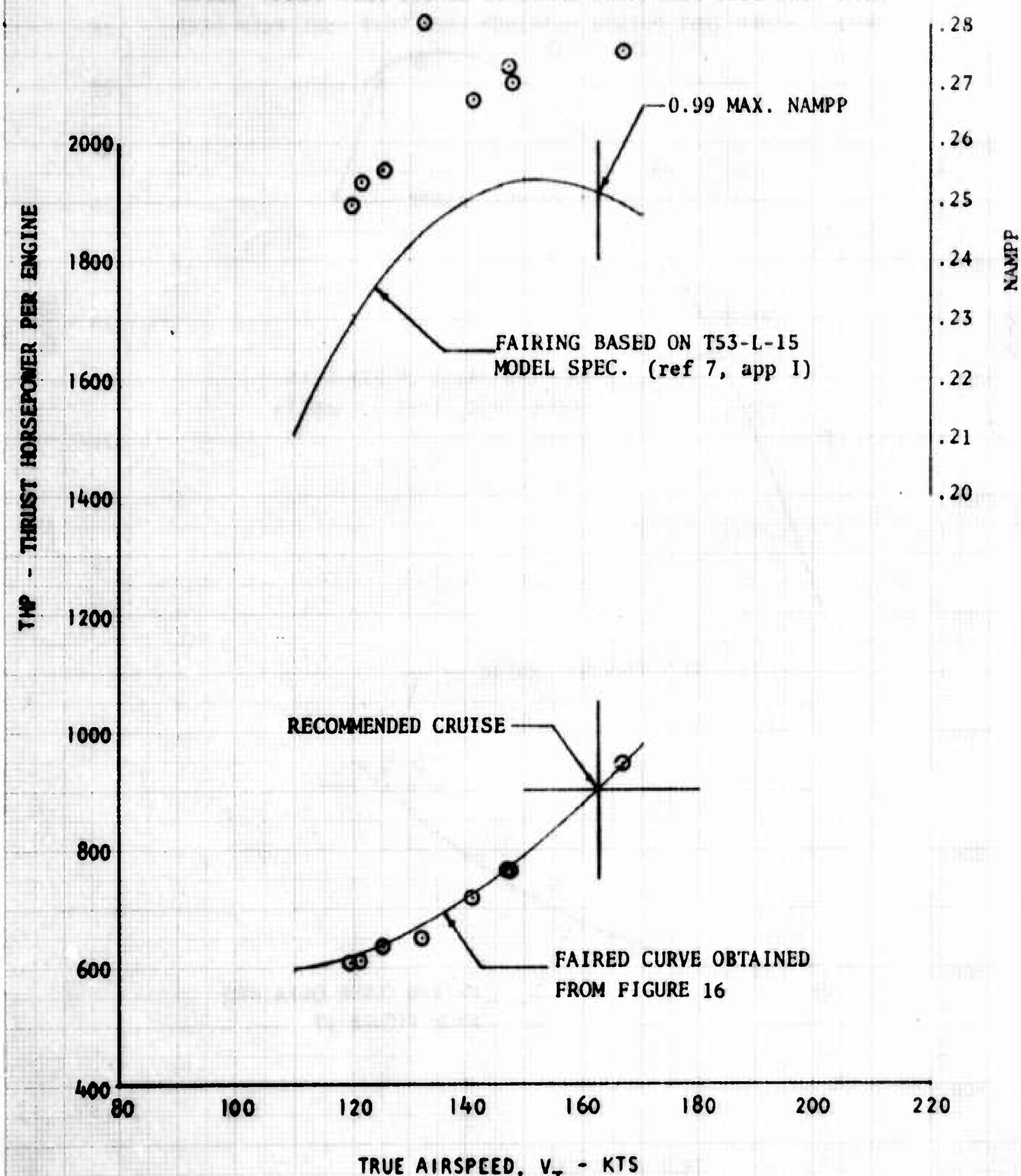


FIGURE No. 22
LEVEL FLIGHT PERFORMANCE
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
SINGLE ENGINE

AVG OAT	AVG. GROSS WEIGHT	AVG. PRESSURE ALTITUDE	AVG. C.G.	STORE CONFIG.
1.8°C	15100 LBS	5000 FT	25.6 %MAC	C

NOTE: NAMPP TEST POINTS OBTAINED FROM TEST FUEL FLOW DATA

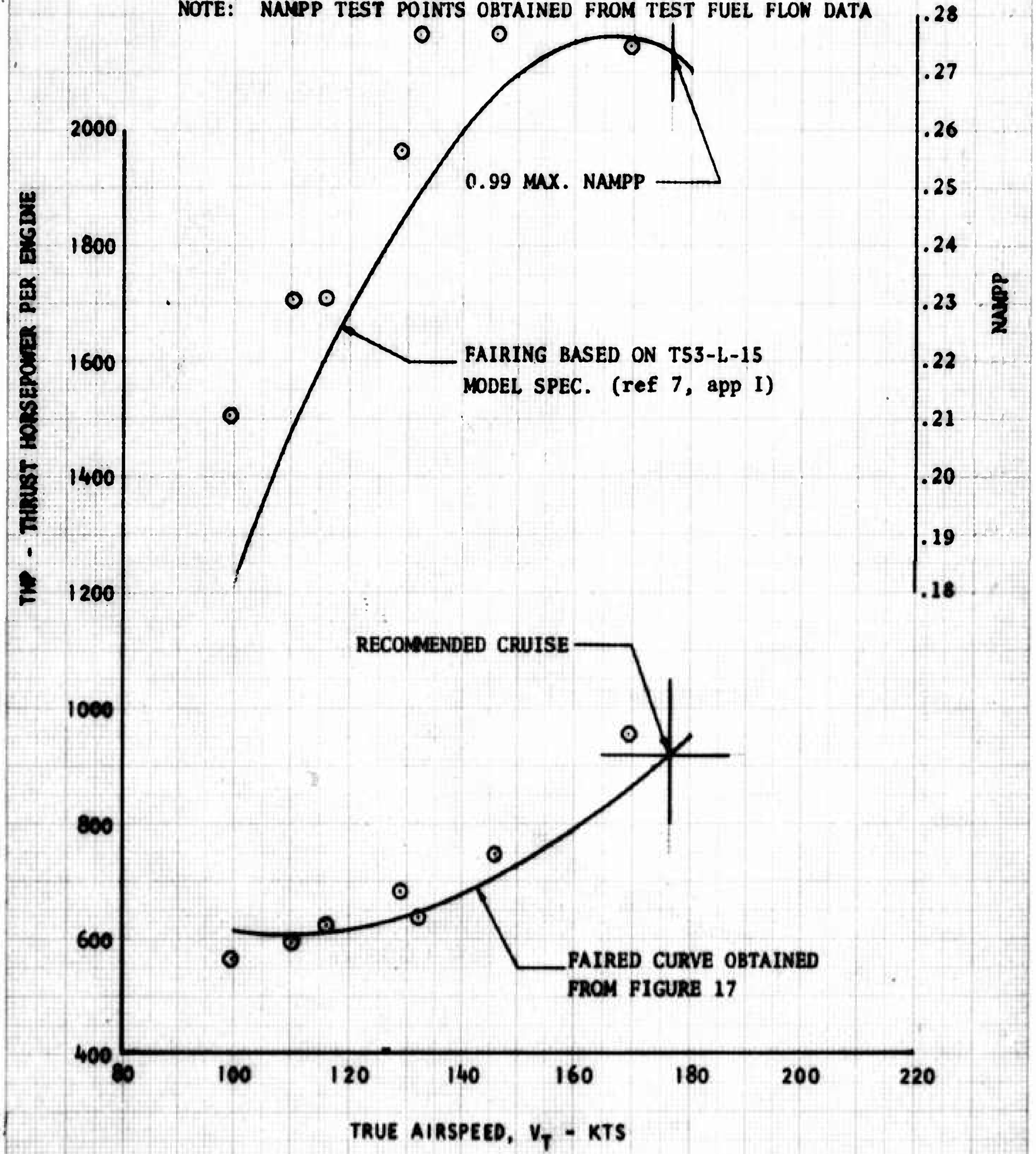


FIGURE No. 23

SERVICE CEILING CLIMB SUMMARY

OV-1D (PRE-PRODUCTION) USA S/N 67-18899

SINGLE ENGINE @ MRP
T53-L-15 SPEC. ENGINE
STANDARD DAY

MID C.G.
STORE CONFIG. A
CRUISE CONFIG.

NOTE: DATA DERIVED FROM FIGURE 24

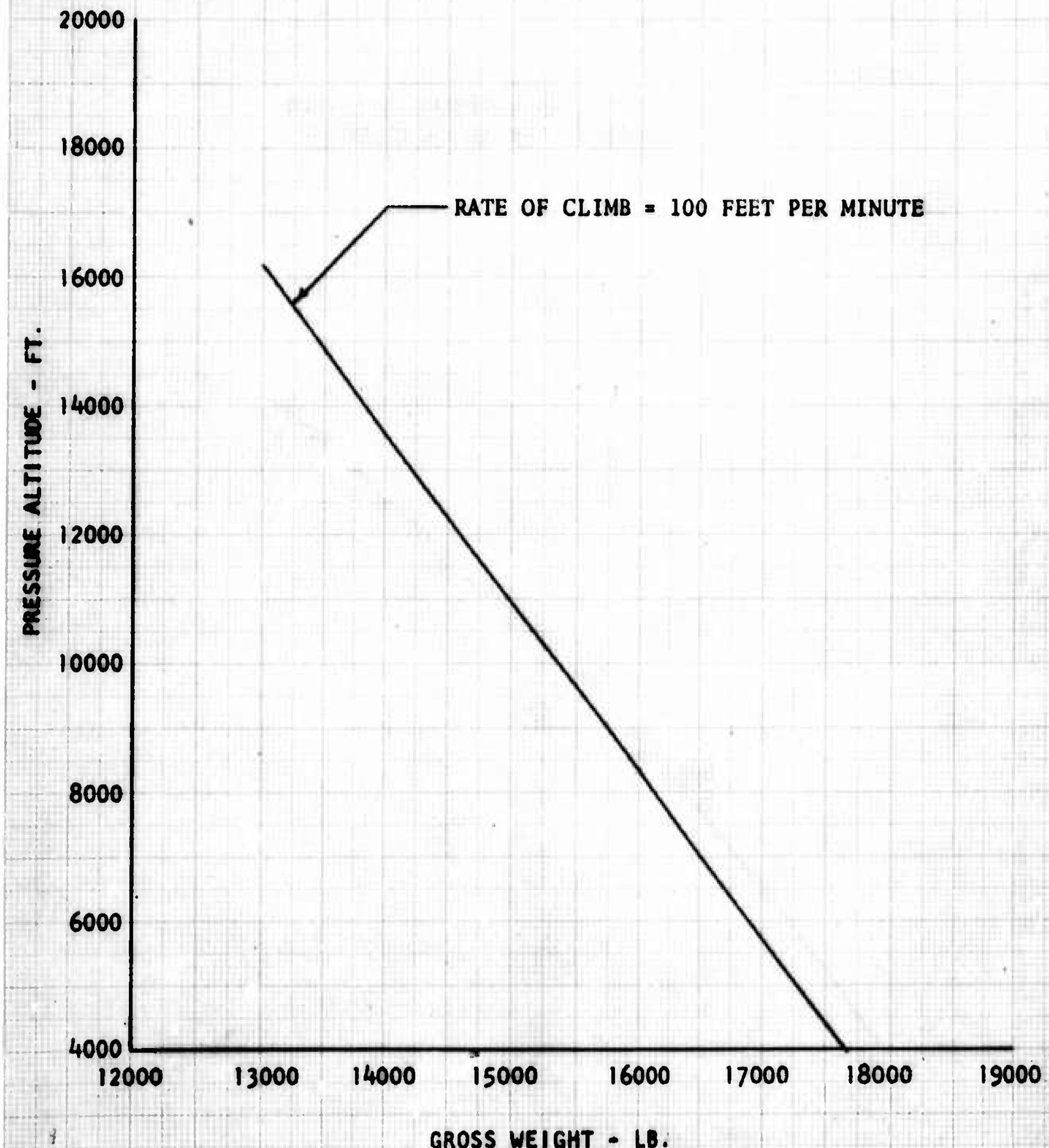


FIGURE No. 24

SINGLE ENGINE CLIMB PERFORMANCE

OV-1D (PRE-PRODUCTION) USA S/N 67-18899

CRUISE CONFIGURATION

SYM	AVG. GROSS WEIGHT	AVG. PRESSURE ALTITUDE	AVG. C.G.	STORE CONFIG.	AVG OAT
⊡	16000 LBS	10700 FT	25.0 %MAC	A	-2.0°C
◺	16000 LBS	7000 FT	25.0 %MAC	A	3.0°C
⊖	15700 LBS	5000 FT	25.0 %MAC	A	5.2°C
⊖✓	15700 LBS	5000 FT	25.0 %MAC	A	5.2°C
⊙	16000 LBS	14000 FT	25.0 %MAC	C	-17.5°C
⌓	16000 LBS	5000 FT	25.8 %MAC	C	2.4°C

NOTE:

1. ⊖ SYMBOL DENOTES BALL CENTER TECHNIQUE
2. ⊖✓ SYMBOL DENOTES BANK ANGLE TECHNIQUE

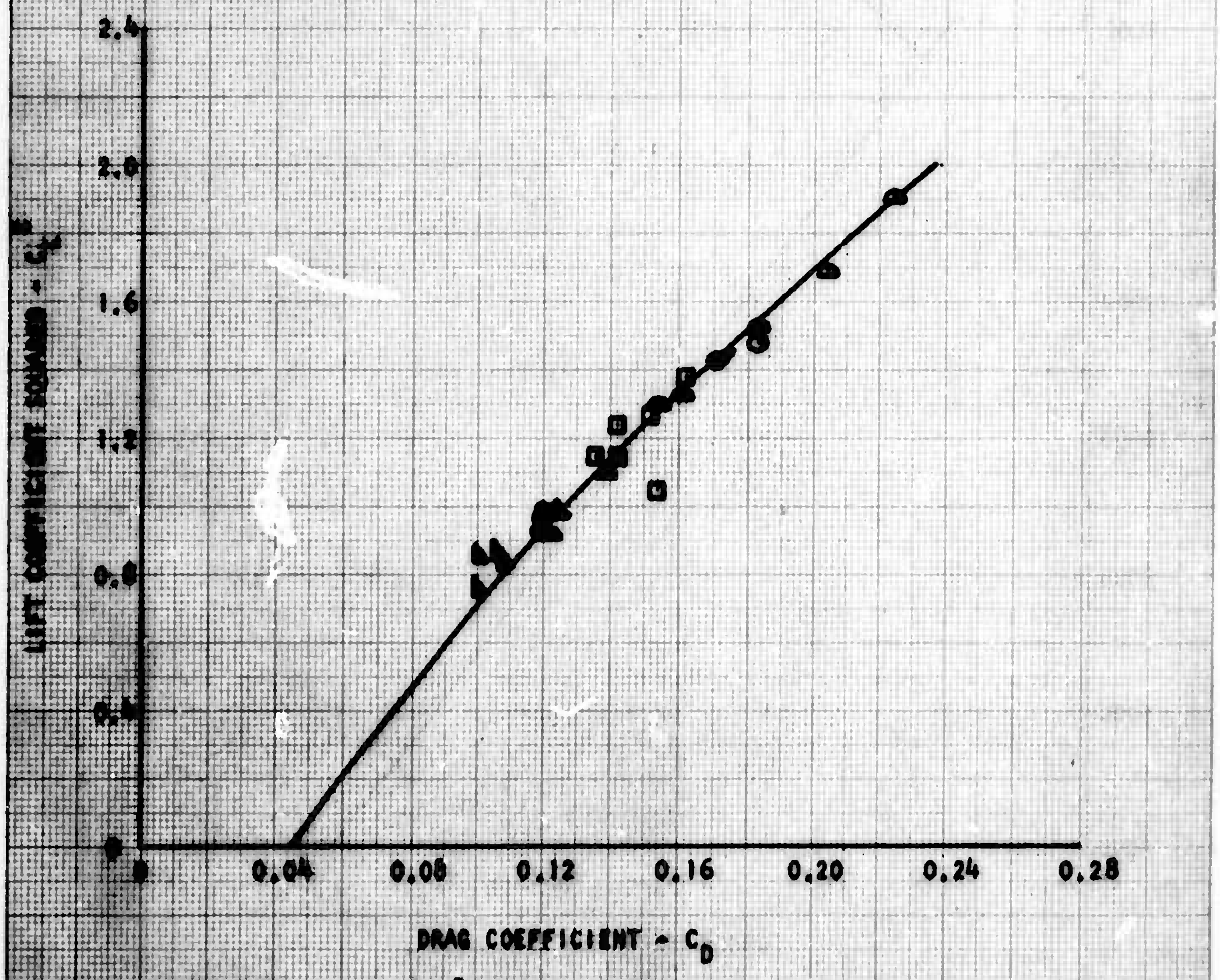


FIGURE No. 25

SINGLE ENGINE CLIMB PERFORMANCE

OV-1D (PRE-PRODUCTION) USA S/N 67-18899

TAKEOFF CONFIGURATION

SYM	AVG. GROSS WEIGHT	AVG. PRESSURE ALTITUDE	AVG. C.G.	STORE CONFIG.	AVG OAT
○	16000 LBS	5000 FT	25.0 %MAC	A	6.0°C
◆	16000 LBS	5000 FT	25.0 %MAC	C	2.5°C

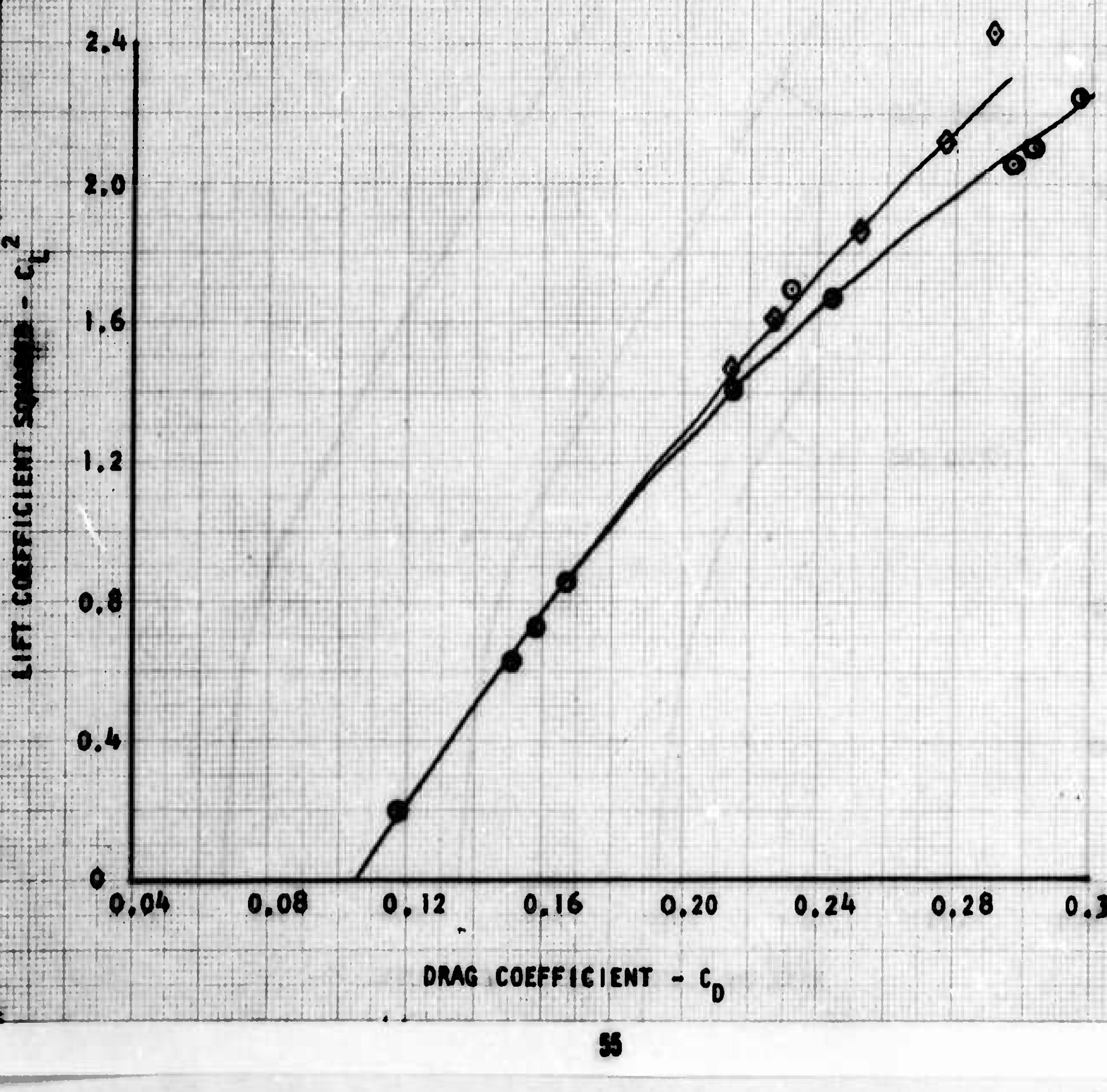


FIGURE No. 26
SINGLE ENGINE CLIMB PERFORMANCE SUMMARY
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
CRUISE CONFIGURATION

STANDARD DAY MID C.G. T53-L-15 SPEC. ENGINE @ MRP (ref 7, app I)

NOTE: DATA DERIVED FROM FIGURE 24

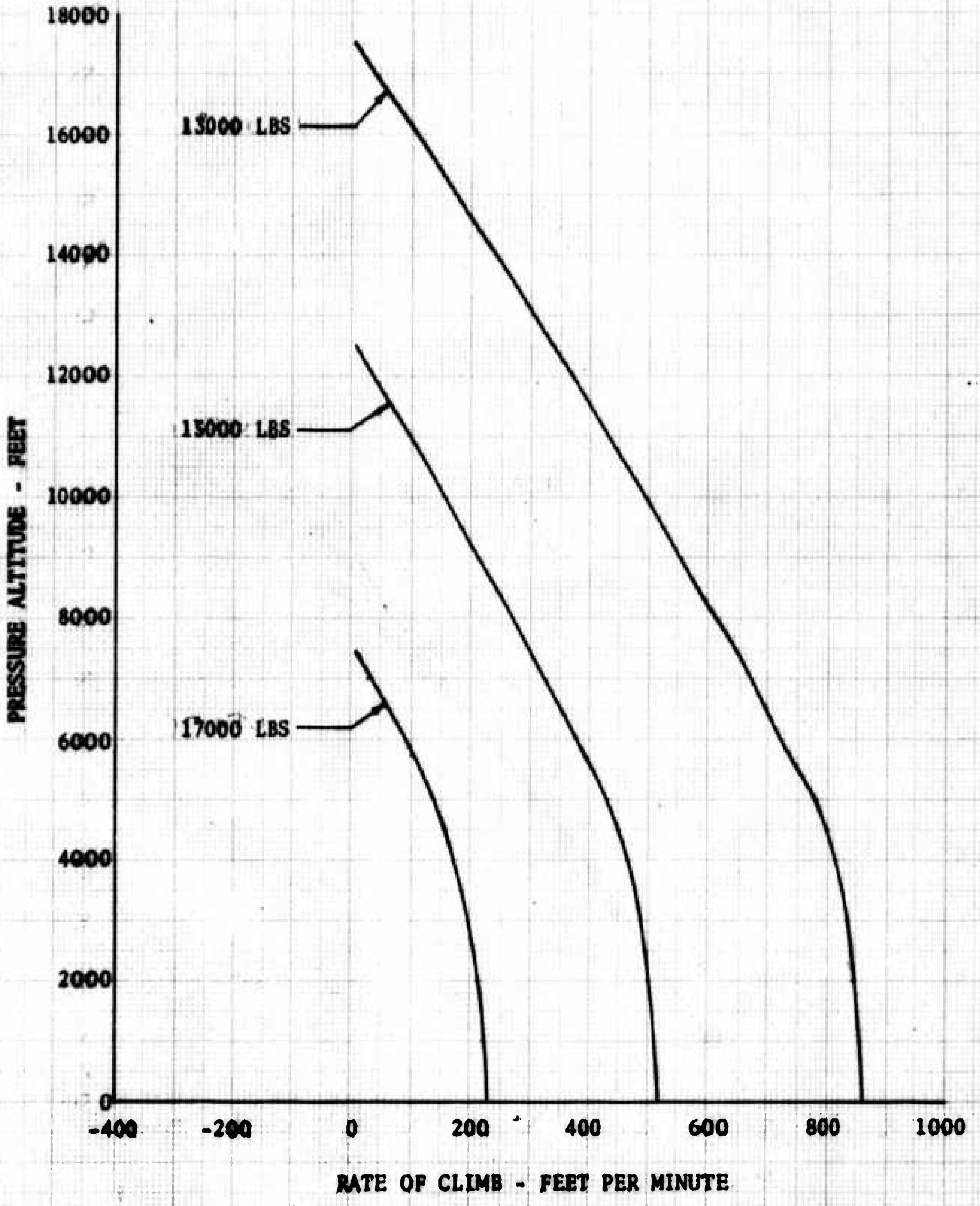


FIGURE No. 27
STALL PERFORMANCE
OV-1D (PRE-PRODUCTION) USA S/N 67-18899

SYM.	AVG. GROSS WEIGHT	AVG. PRESSURE ALTITUDE	AVG. C.G.	AIRCRAFT CONFIG.	AVG OAT
△	16100 LBS	5000 FT	30.2 %MAC	G	5.5°C
○	15950 LBS	5000 FT	30.2 %MAC	CR	5.2°C
⌓	16050 LBS	5000 FT	30.2 %MAC	L	5.1°C
□	15750 LBS	5000 FT	30.2 %MAC	PA	5.4°C

NOTE:

1. CLEAR SYMBOLS DENOTE CONFIGURATION A.
2. FLAGGED SYMBOLS DENOTE CONFIGURATION C.

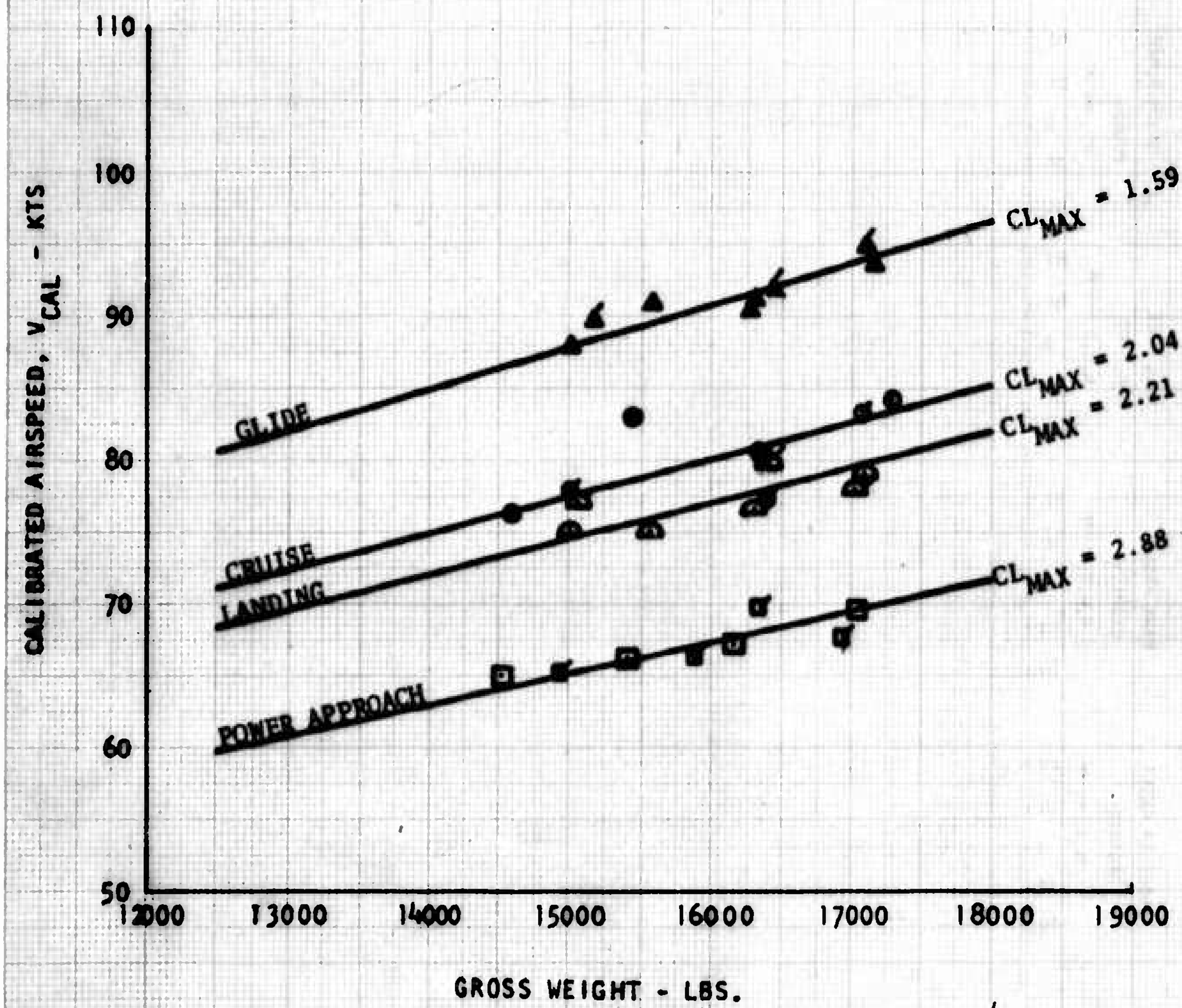


Figure 28a. Stall Characteristics.

OV-1D (Preproduction) USA 67-18899

LANDING CONFIGURATION

TRIM AIRSPEED	AVG. GROSS WEIGHT	AVG. C.G.	AVG. PRESSURE ALTITUDE	STORE CONFIG.
96 KIAS	17,100 LB.	28.9 %MAC	4,550 FT.	A

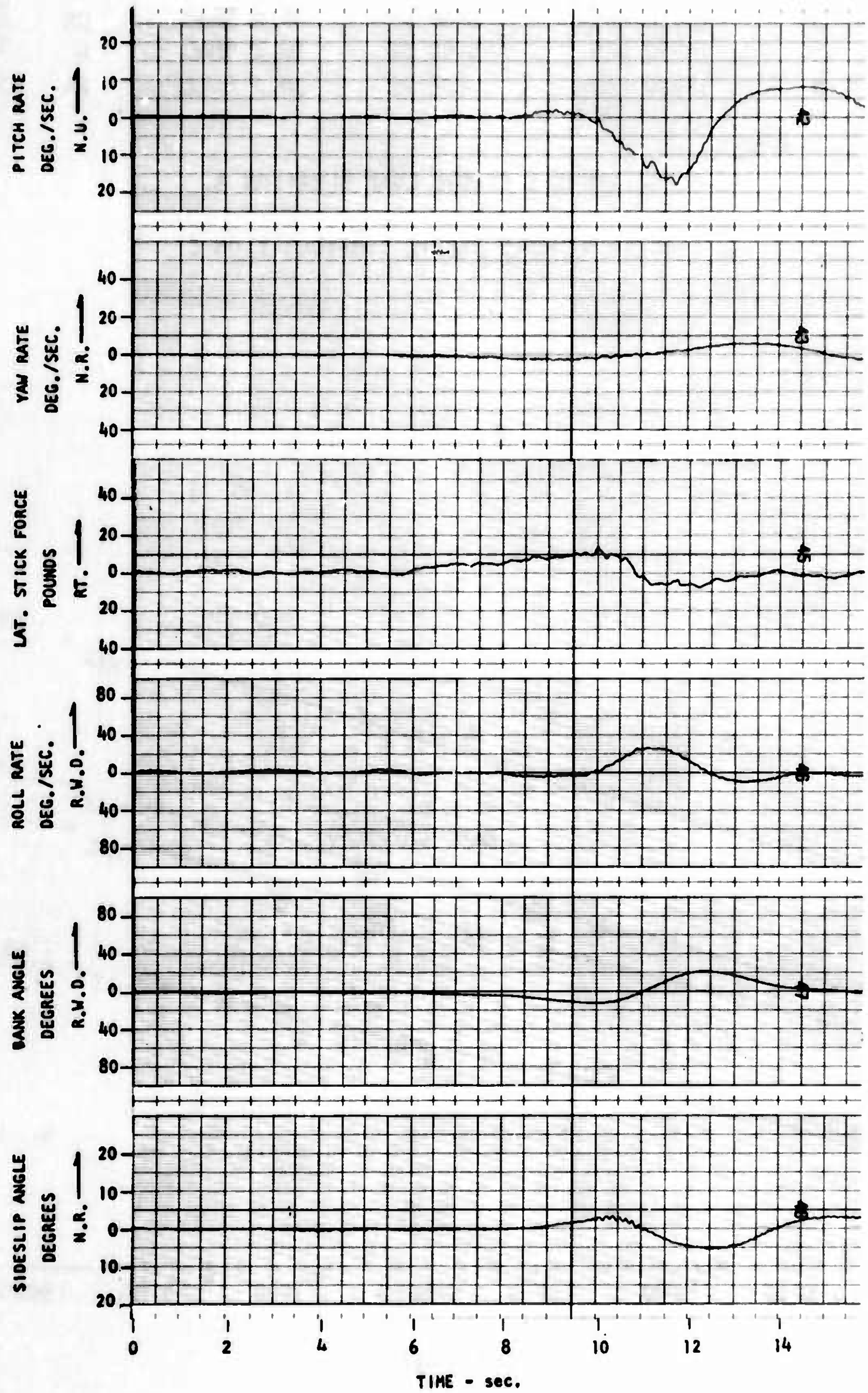


Figure 28b. Stall Characteristics.

OV-1D (Preproduction) USA 67-18899

LANDING CONFIGURATION

TRIM AIRSPEED	AVG. GROSS WEIGHT	AVG. C.G.	AVG. PRESSURE ALTITUDE	STORE CONFIG.
96 KIAS	17,100 LB.	28.9 %MAC	4,550 FT.	A

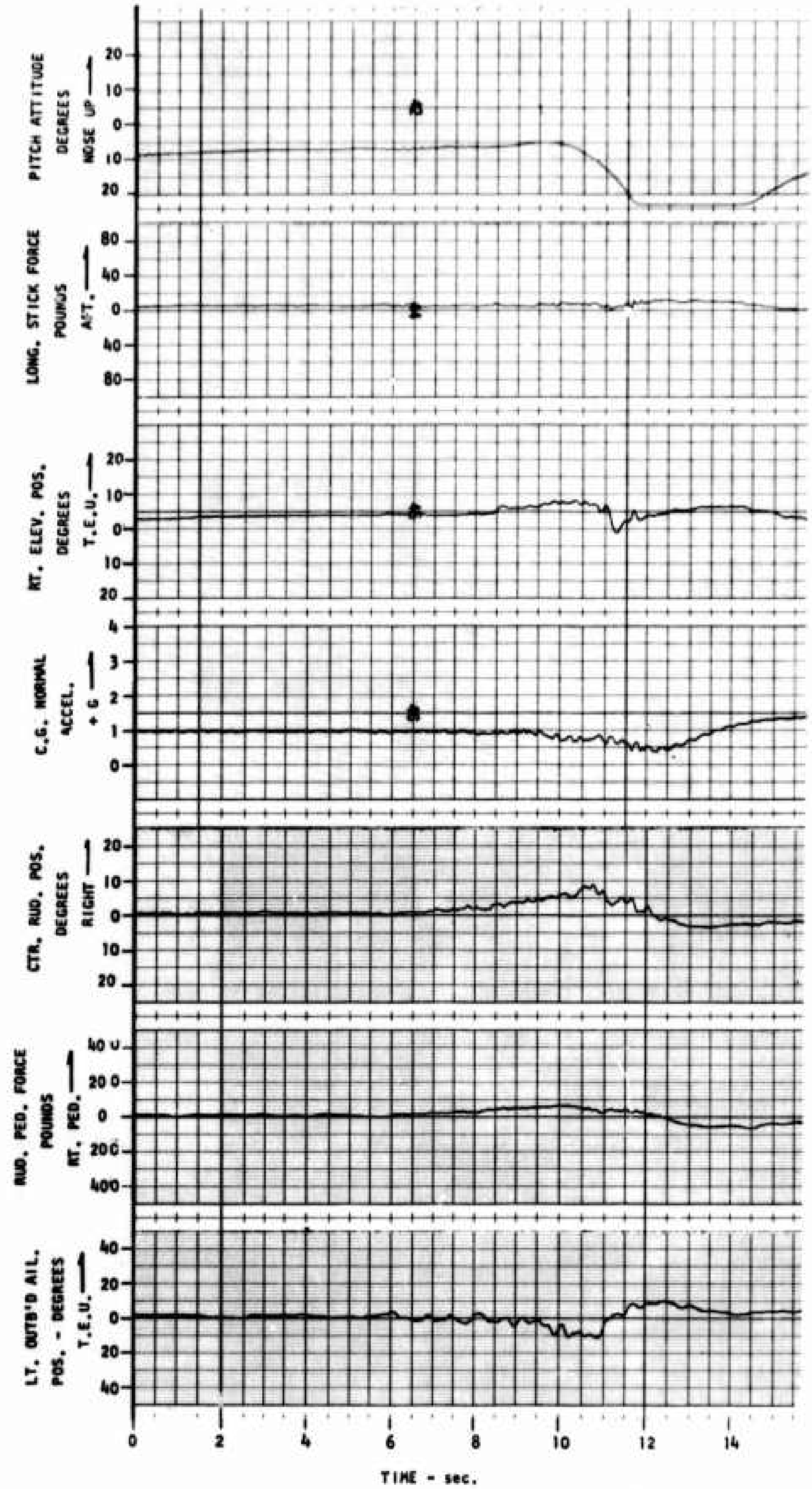


Figure 29a. Stall Characteristics.

OV-1D (Preproduction) USA 67-18899

POWER APPROACH CONFIGURATION

TRIM AIRSPEED	AVG. GROSS WEIGHT	AVG. C.G.	AVG. PRESSURE ALTITUDE	STORE CONFIG.
87 KIAS	17,050 LB.	28.9 %MAC	5,050 FT.	A

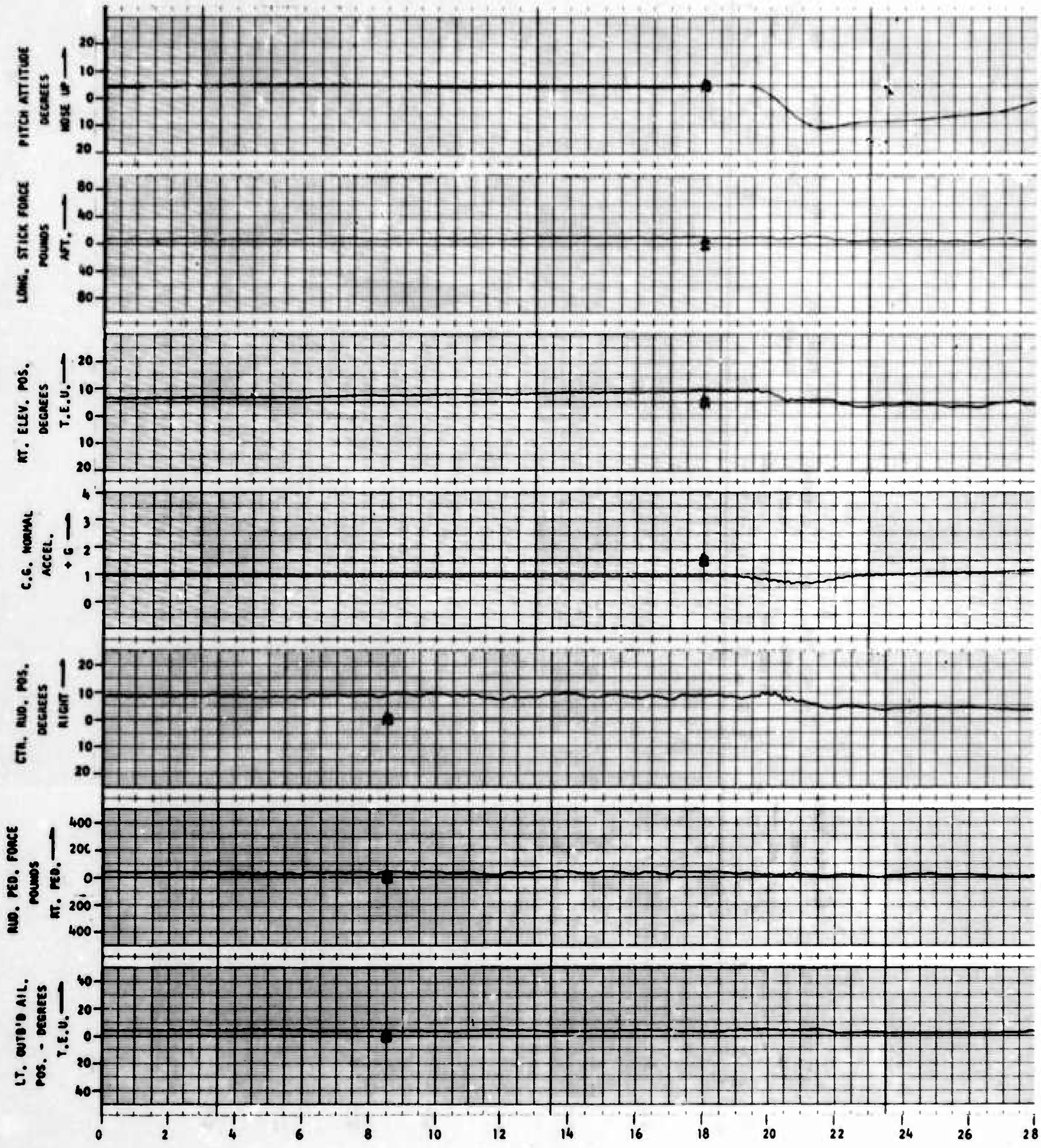


Figure 29b. Stall Characteristics.

OV-1D (Preproduction) USA 67-18899

POWER APPROACH CONFIGURATION

TRIM AIRSPEED	AVG. GROSS WEIGHT	AVG. C.G.	AVG. PRESSURE ALTITUDE	STORE CONFIG.
87 KIAS	17,050 LB.	28.9 %MAC	5,050 FT.	A

FIGURE No. 30
STATIC LONGITUDINAL STABILITY (STICK FIXED & FREE)
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
CRUISE CONFIGURATION

SYM	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
○	16900	29.2	5100	A
□	16500	29.2	4400	A
◇	16100	29.2	5000	A
△	17400	24.0	5200	A
◇	17300	24.0	4900	A
▽	17200	24.0	4600	A

NOTE: SHADED SYMBOLS DENOTE TRIM.

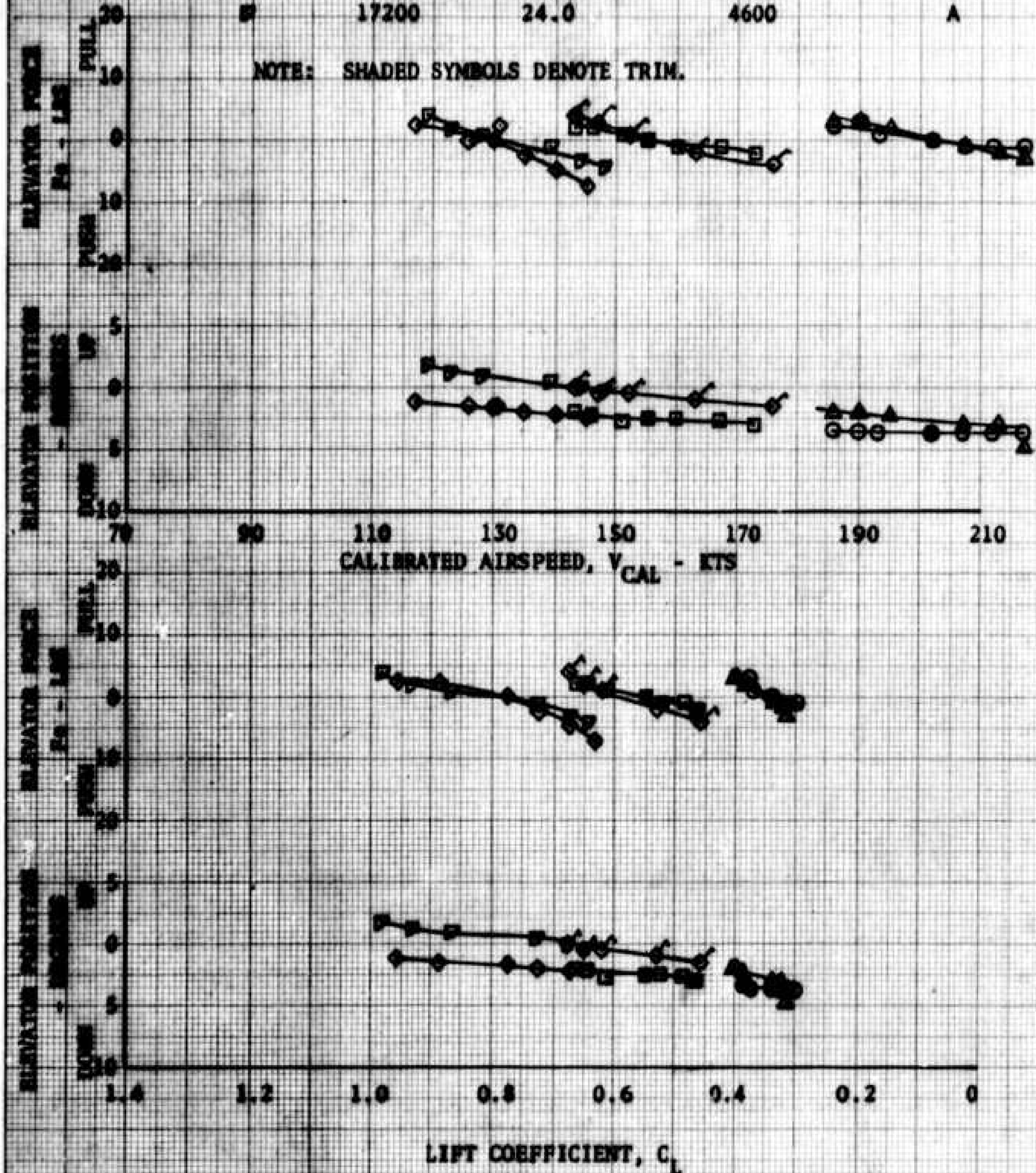


FIGURE No. 30

STATIC LONGITUDINAL STABILITY (STICK FIXED & FREE)

OV-1D (PRE-PRODUCTION) USA S/N 67-18899

CRUISE CONFIGURATION

SYM	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
○	16900	29.2	5100	A
□	16500	29.2	4400	A
◇	16100	29.2	5000	A
△	17400	24.0	5200	A
◇ (flagged)	17300	24.0	4900	A
▽ (in square)	17200	24.0	4600	A

NOTE: SHADED SYMBOLS DENOTE TRIM.

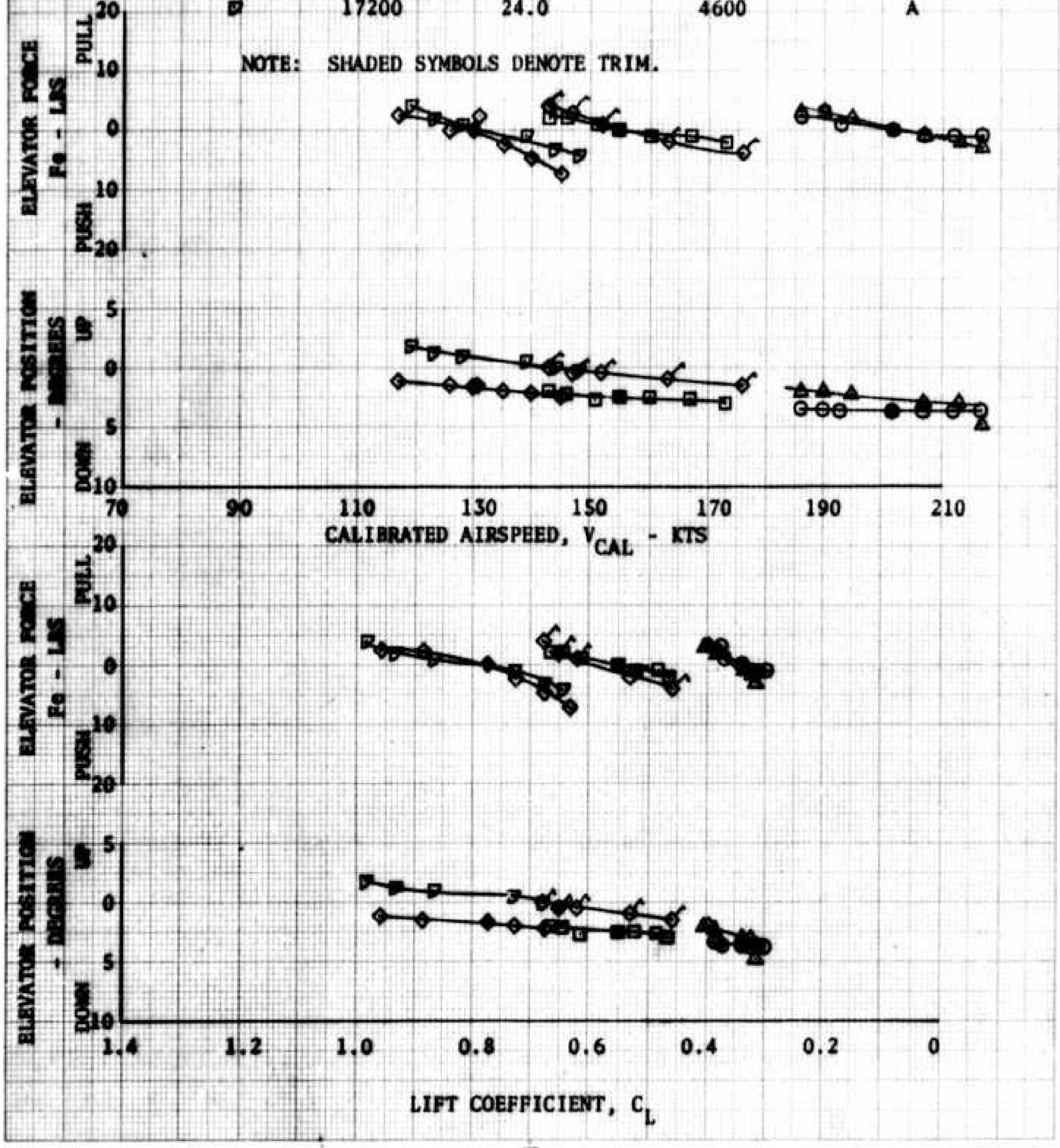


FIGURE No. 31

STATIC LONGITUDINAL STABILITY (STICK FIXED & FREE)

OV-1D (PRE-PRODUCTION) USA S/N 67-18899

LANDING CONFIGURATION

SYM	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
O	15500	28.7	5000	A
□	16700	24.7	3300	A

NOTE: SHADED SYMBOLS DENOTE TRIM.

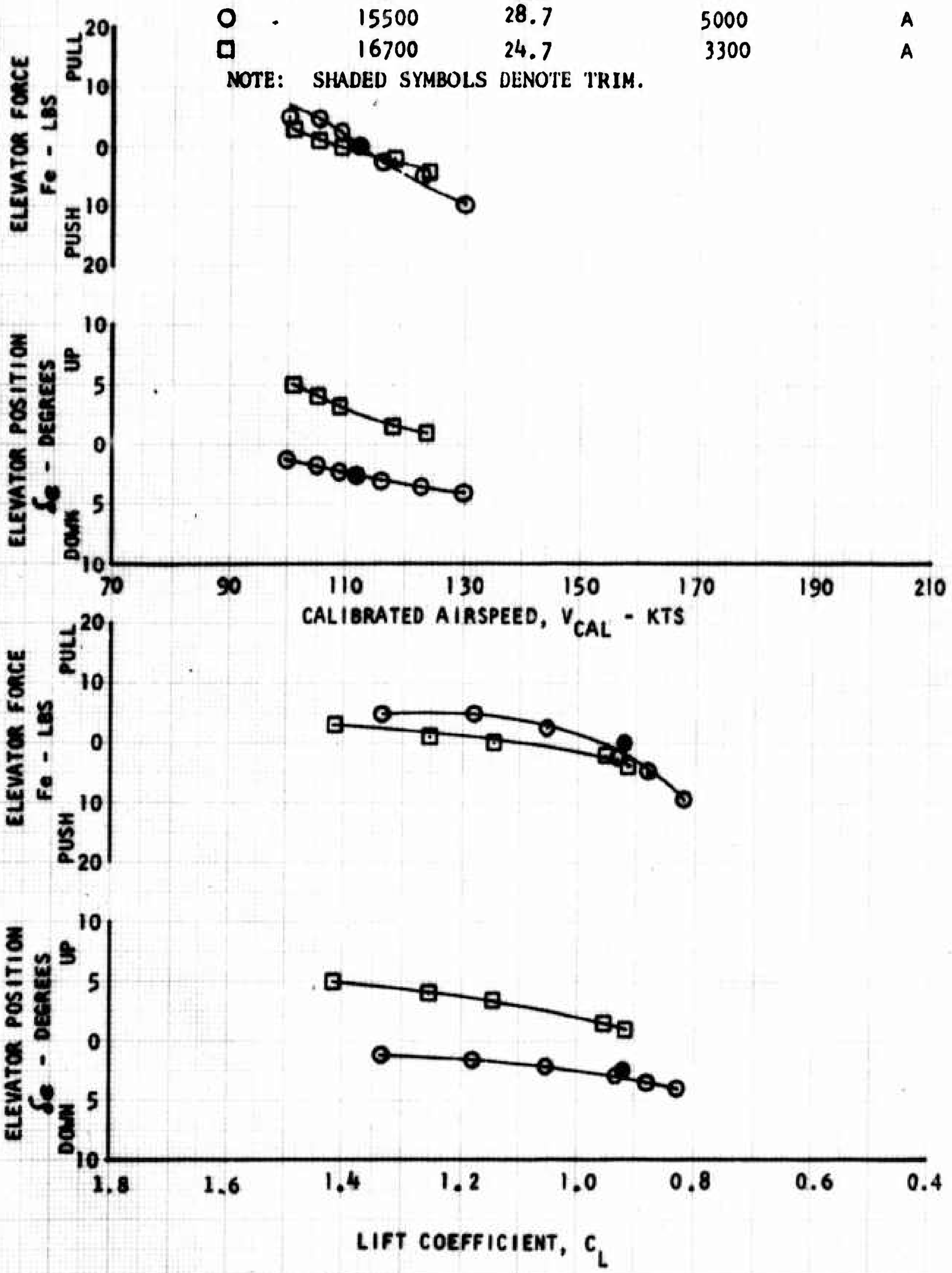


FIGURE No. 32
STATIC LONGITUDINAL STABILITY (STICK FIXED & FREE)
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
POWER CONFIGURATION

SYM	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
O	17100	24.7	5000	A

NOTE: SHADED SYMBOLS DENOTE TRIM.

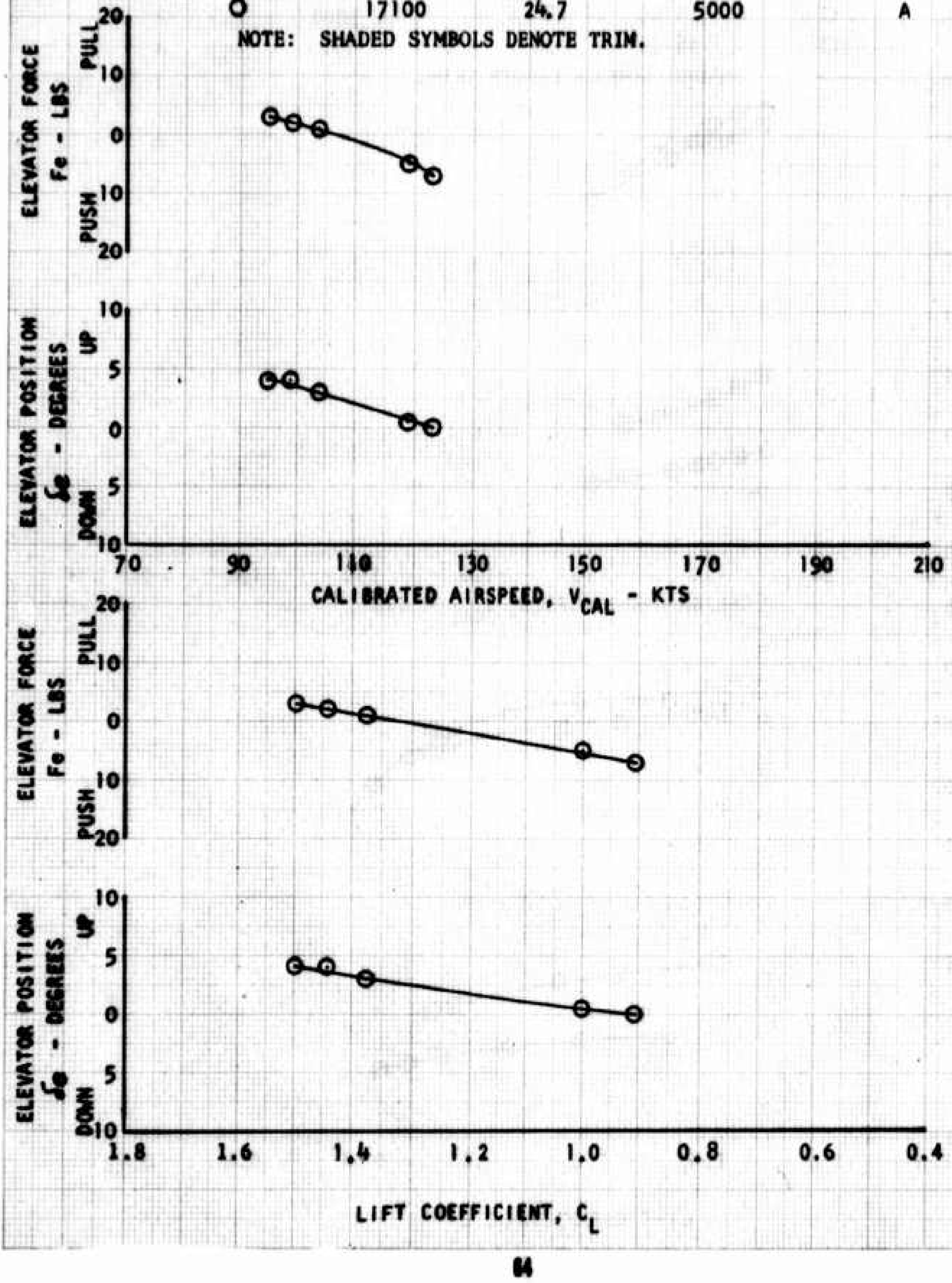


FIGURE No. 33

STATIC LONGITUDINAL STABILITY (STICK FIXED & FREE)

OV-1D (PRE-PRODUCTION) USA S/N 67-18899

WAVE-OFF CONFIGURATION

SYM	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
O	15300	28.7	5000	A
□	16750	24.7	4000	A

NOTE: SHADED SYMBOLS DENOTE TRIM.

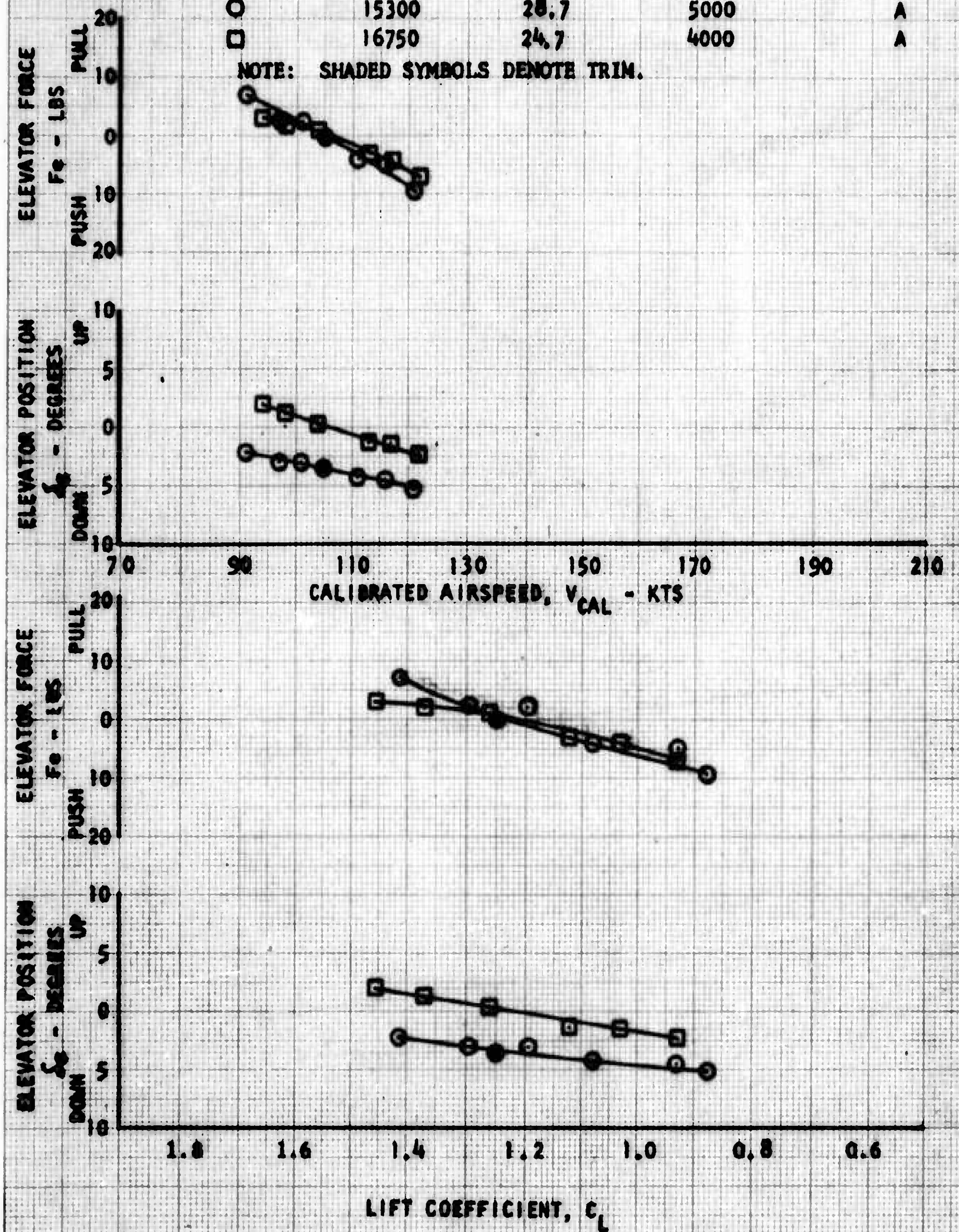


FIGURE No. 34

STATIC LONGITUDINAL STABILITY (STICK FIXED & FREE)

OV-1D (PRE-PRODUCTION) USA S/N 67-18899

POWER APPROACH CONFIGURATION

SYM	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
O	16500	24.6	4500	A
□	16150	29.0	4660	A

NOTE: SHADED SYMBOLS DENOTE TRIM.

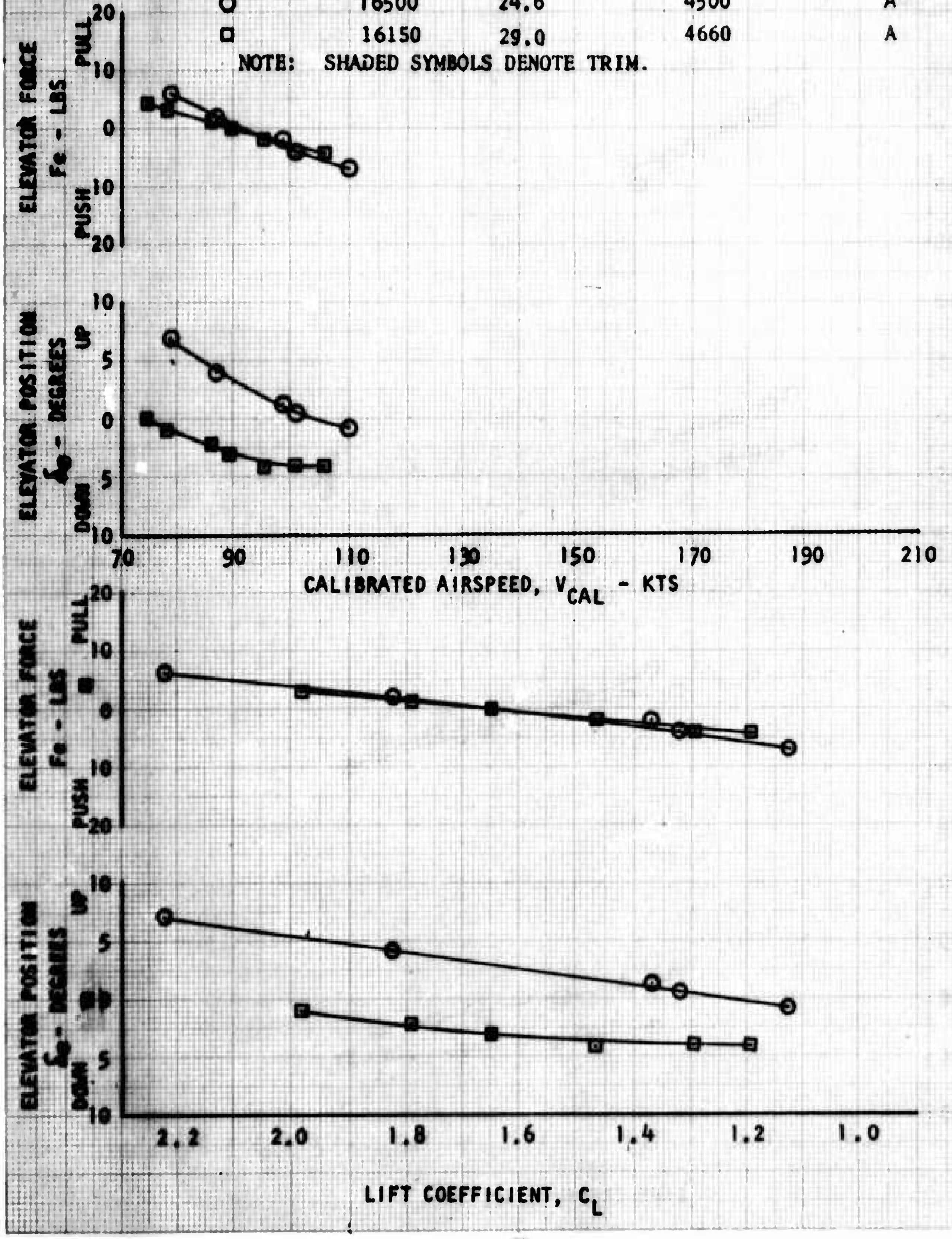


FIGURE No. 35
STATIC LONGITUDINAL STABILITY (STICK FIXED & FREE)
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
CRUISE CONFIGURATION

SYM	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
○	16750	31.5	4800	C
⊡	16500	31.6	4900	C
△	16500	24.3	5000	C
▽	16500	24.3	5000	C

NOTE: SHADED SYMBOLS DENOTE TRIM.

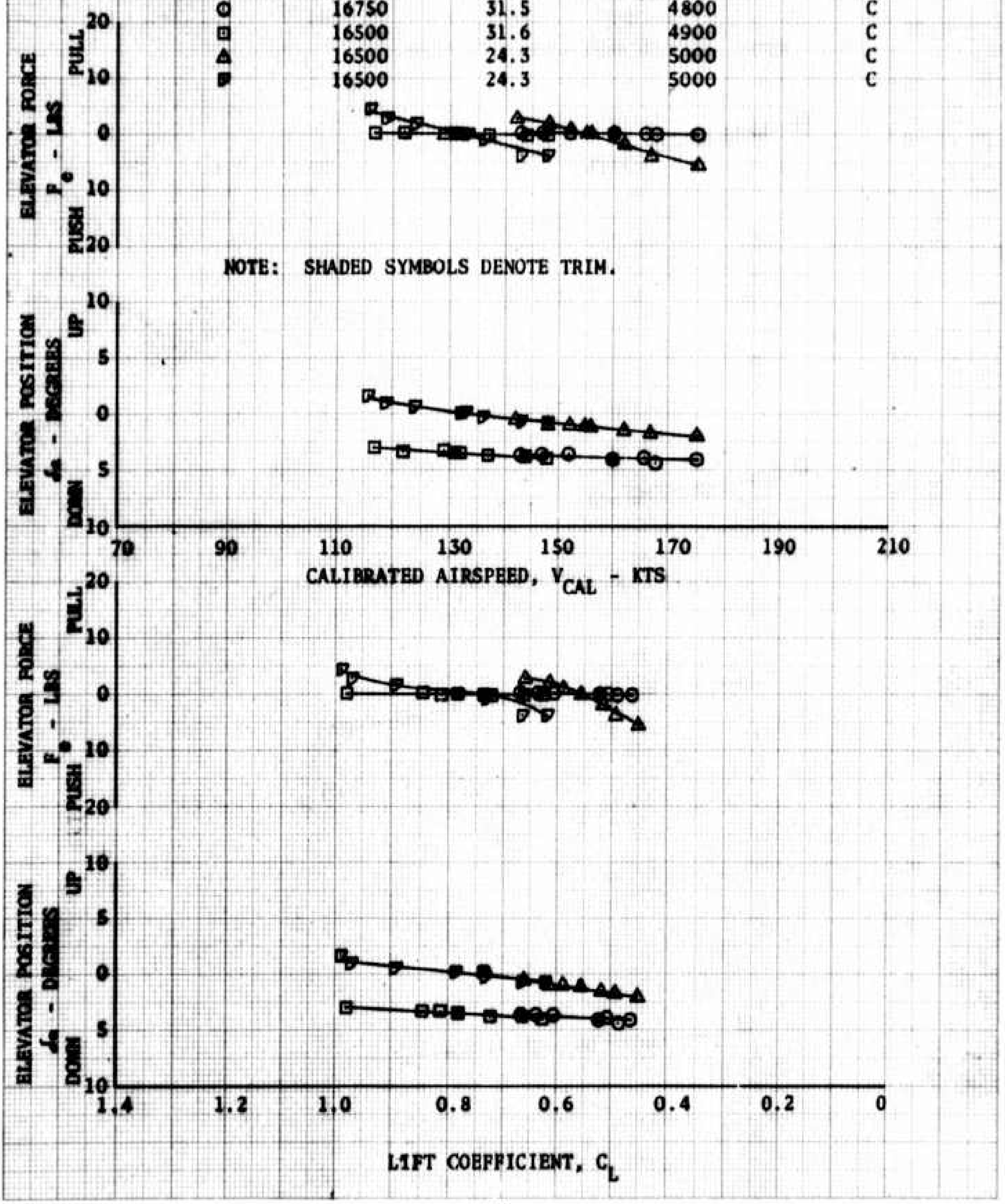


FIGURE No. 36

STATIC LONGITUDINAL STABILITY (STICK FIXED & FREE)

OV-1D (PRE-PRODUCTION) USA S/N 67-18899

WAVE-OFF CONFIGURATION

SYM	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
□	15300	31.2	7000	C

NOTE: SHADED SYMBOLS DENOTE TRIM.

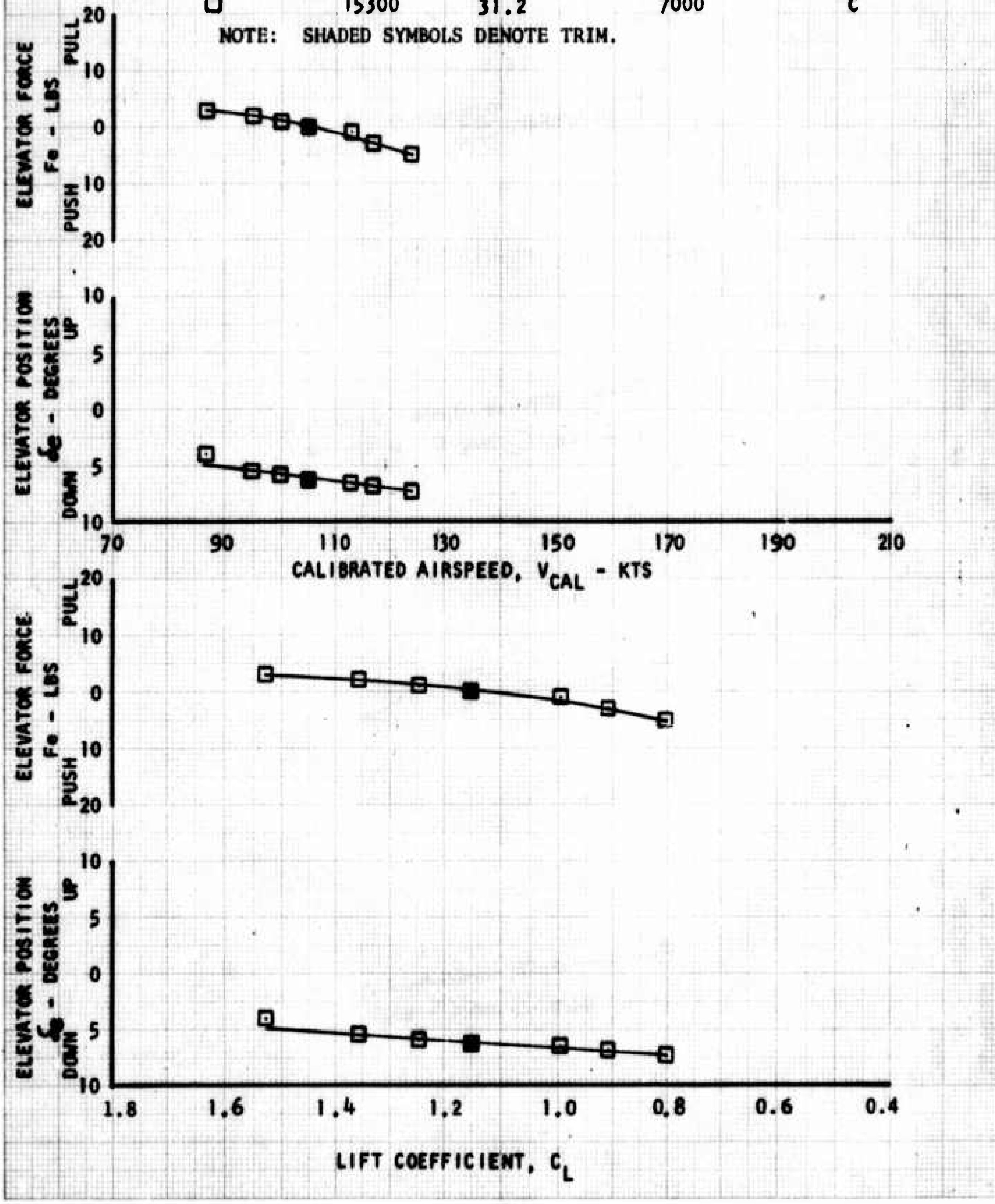


FIGURE No. 37

STATIC LONGITUDINAL STABILITY (STICK FIXED & FREE)

OV-1D (PRE-PRODUCTION) USA S/N 67-18899

POWER APPROACH CONFIGURATION

SYM	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
○	15900	24.3	4480	C
□	15560	31.4	5300	C

NOTE: SHADED SYMBOLS DENOTE TRIM.

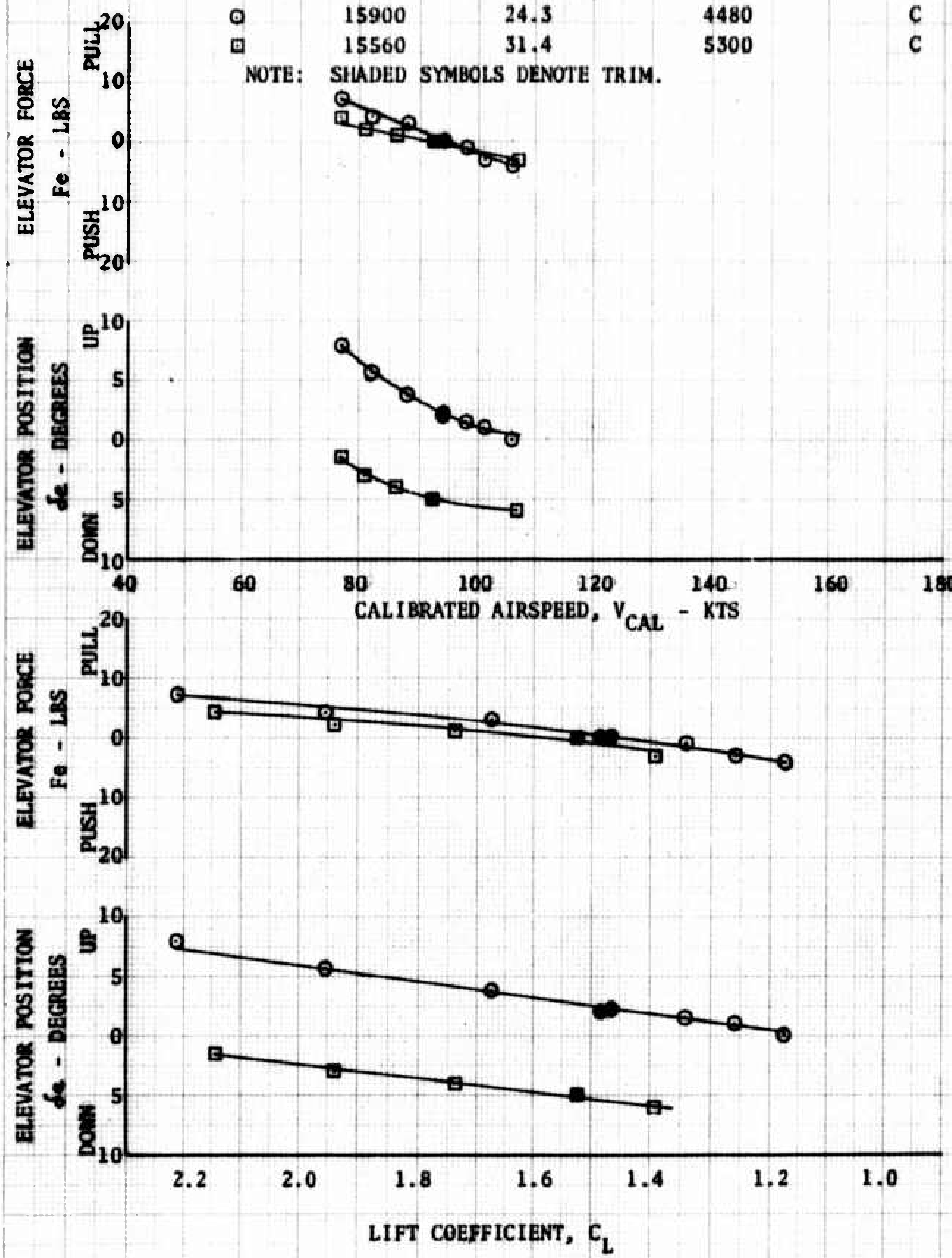


FIGURE No. 38
DYNAMIC LONGITUDINAL STABILITY (PHUGOID)
OV-1D (PRE-PRODUCTION) USA 67-18899
CRUISE CONFIGURATION

SYMBOL	TRIM AIRSPEED KT.	AVG. GROSS WEIGHT LB.	AVG. C.G. %MAC	AVG. PRESSURE ALTITUDE FT.	STORE CONFIG.
————	160	17200	24.7	4900	A
— — — —	135	17000	24.9	5000	A

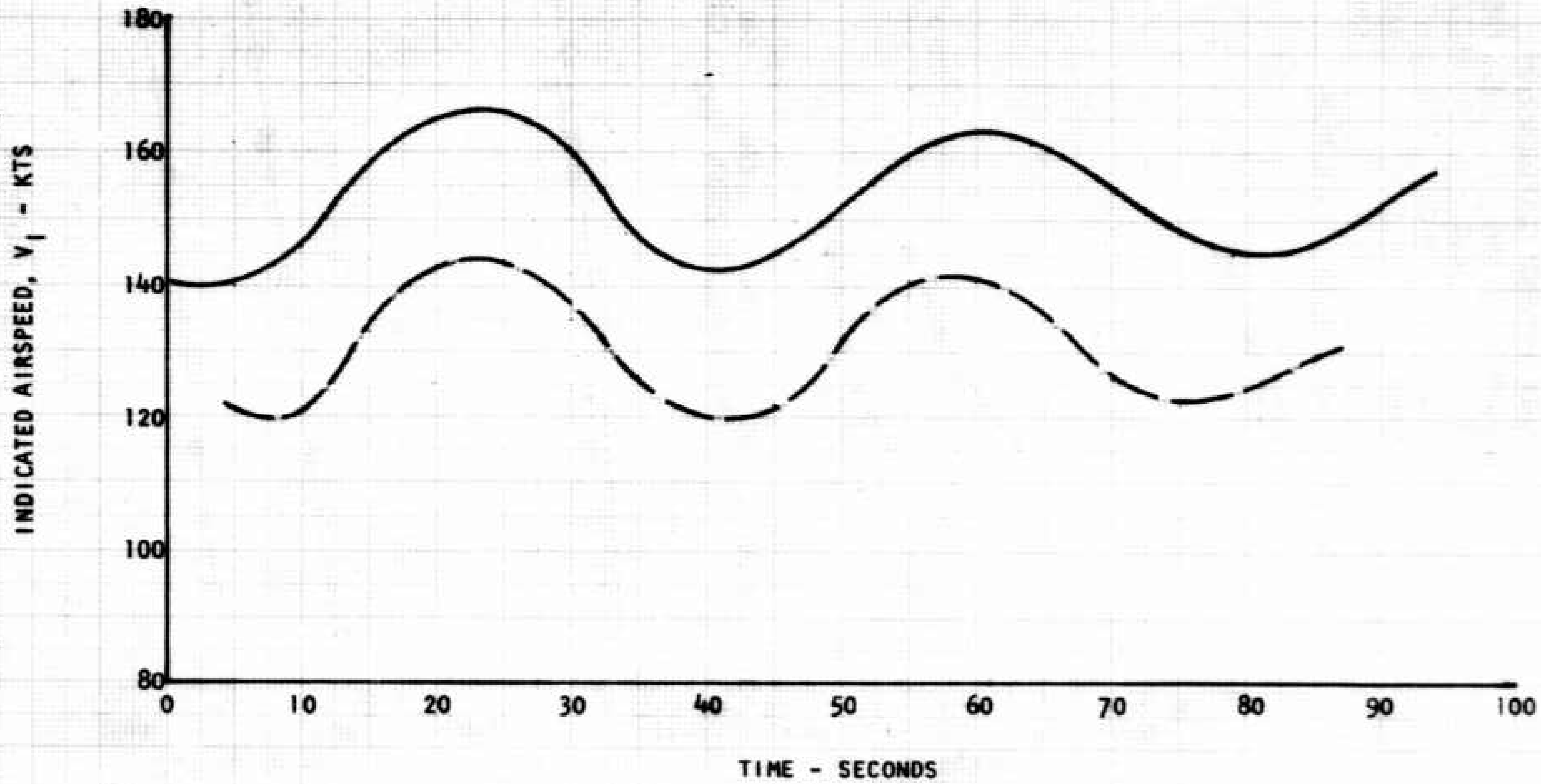


FIGURE No. 39
DYNAMIC LONGITUDINAL STABILITY (PHUGOID)
OV-1D (PRE-PRODUCTION) USA 67-18899
CRUISE CONFIGURATION

SYMBOL	TRIM AIRSPEED KT.	AVG. GROSS WEIGHT LB.	AVG. C.G. %MAC	AVG. PRESSURE ALTITUDE FT.	STORE CONFIG.
———— (solid)	160	16600	29.2	4700	A
— — — (dashed)	135	16150	29.2	5000	A

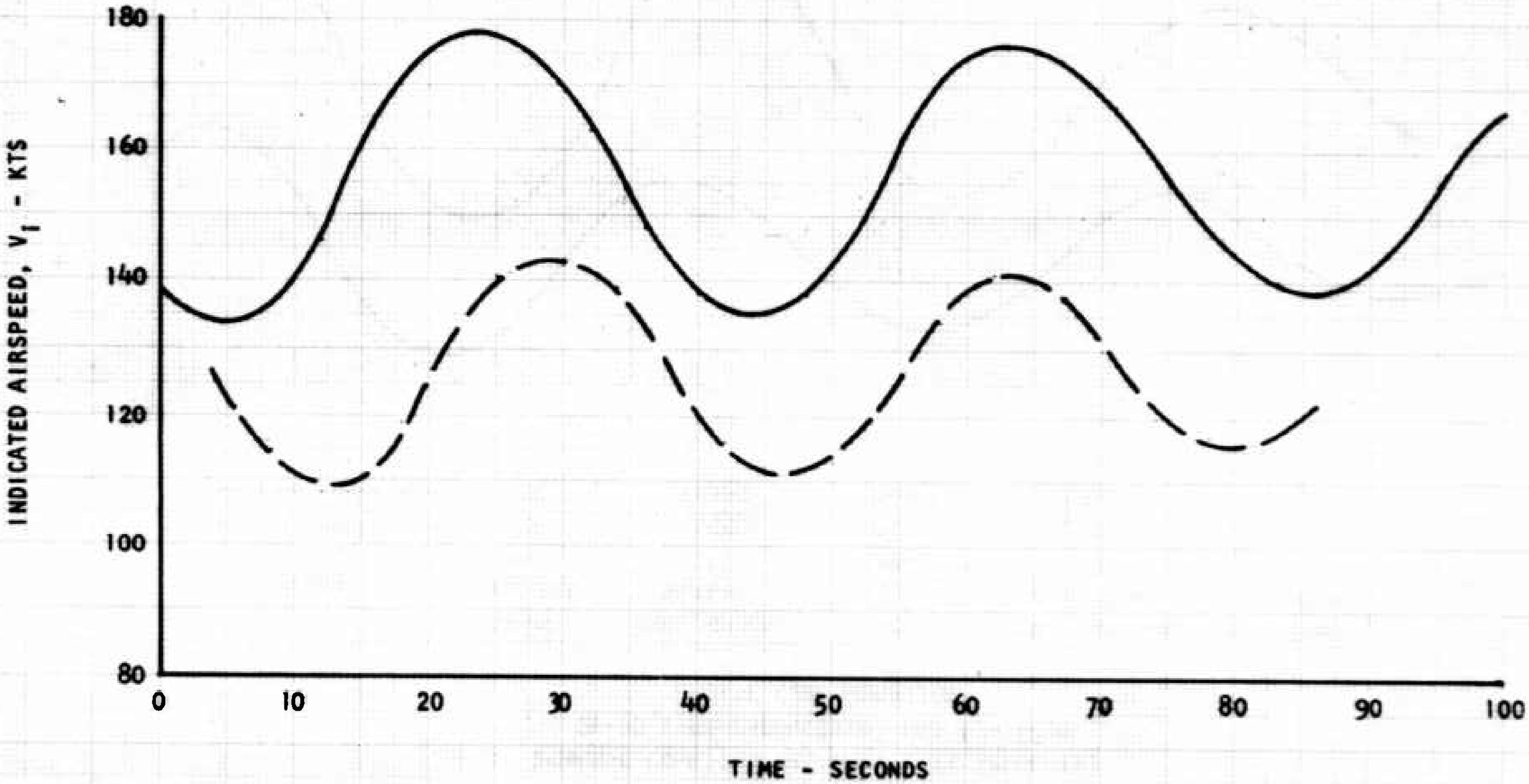


FIGURE No. 40
DYNAMIC LONGITUDINAL STABILITY (PHUGOID)
OV-1D (PRE-PRODUCTION) USA 67-18899
CRUISE CONFIGURATION

SYMBOL	TRIM AIRSPEED KT.	AVG. GROSS WEIGHT LB.	AVG. C.G. %MAC	AVG. PRESSURE ALTITUDE FT.	STORE CONFIG.
———	160	16650	24.4	5100	C
— — —	135	16350	24.5	4750	C

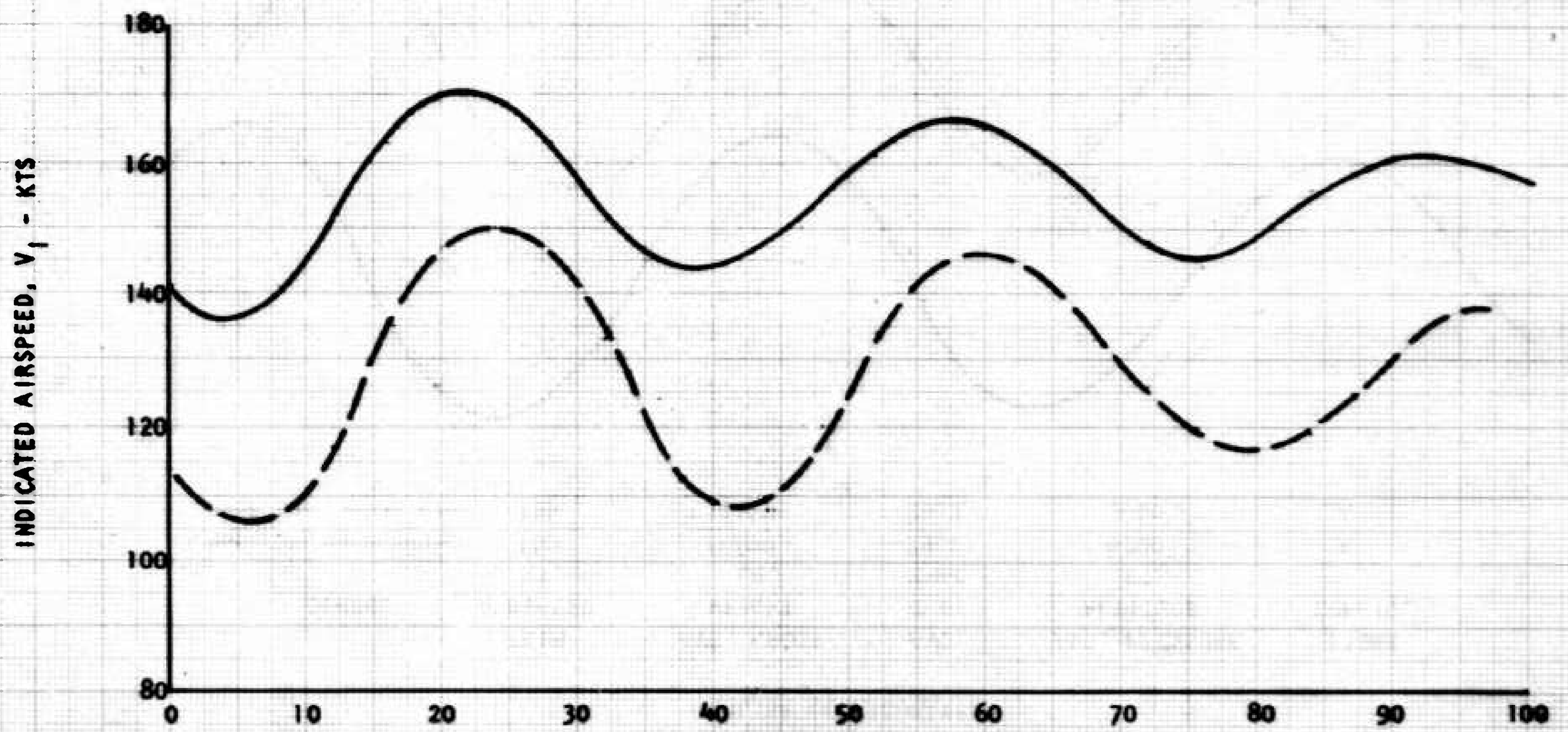


FIGURE No. 41
DYNAMIC LONGITUDINAL STABILITY (PHUGOID)
OV-1D (PRE-PRODUCTION) USA 67-18899
CRUISE CONFIGURATION

SYMBOL	TRIM AIRSPEED KT.	AVG. GROSS WEIGHT LB.	AVG. C.G. %MAC	AVG. PRESSURE ALTITUDE FT.	STORE CONFIG.
———	160	16650	31.5	5000	C
— — —	135	16400	31.6	5000	C

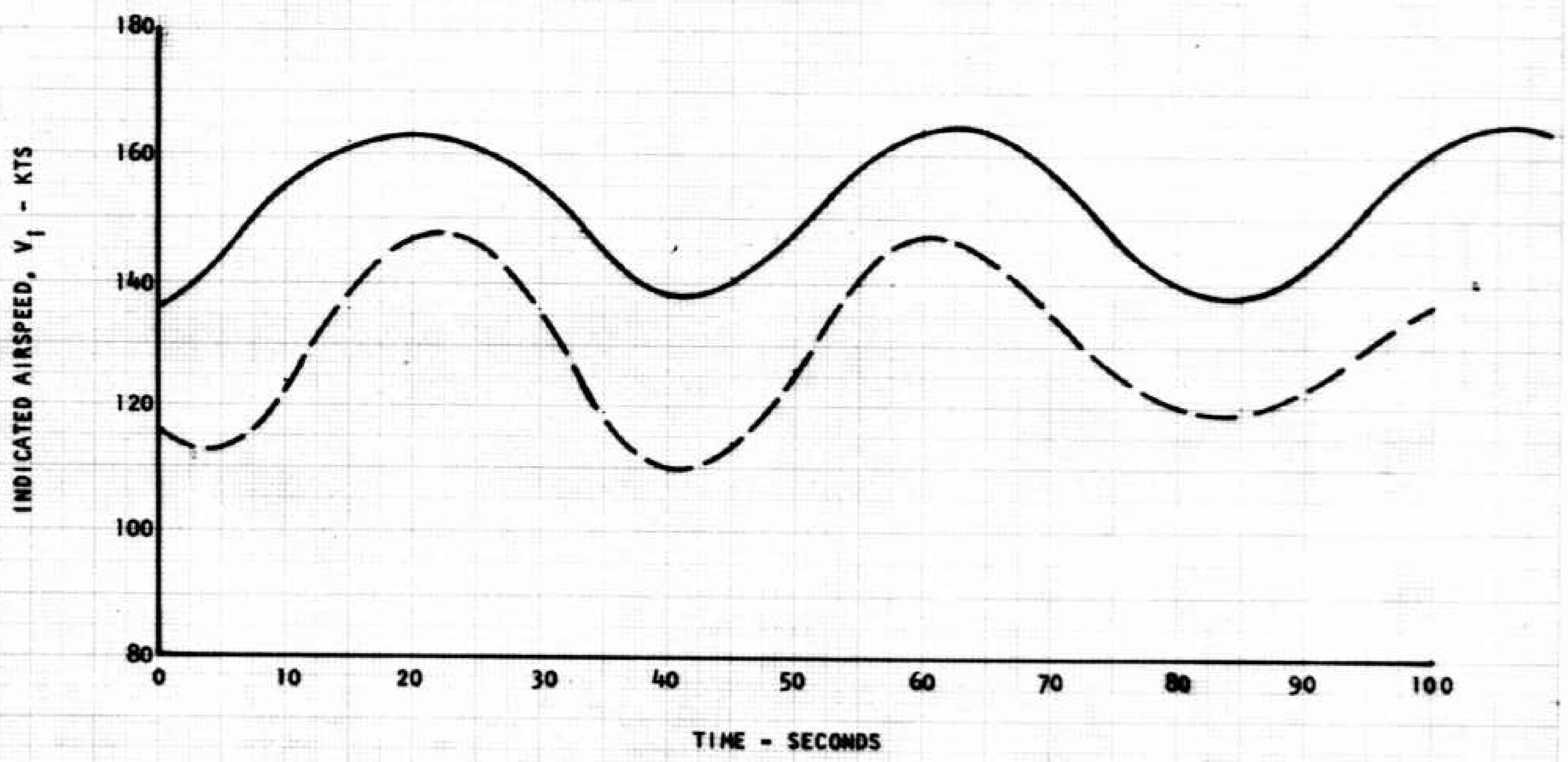


Figure 42. Dynamic Longitudinal Stability (Short Period Mode).

OV-1D (Preproduction) USA 67-18899

CRUISE CONFIGURATION

TRIM AIRSPEED	AVG. GROSS WEIGHT	AVG. C.G.	AVG. PRESSURE ALTITUDE	STORE CONFIG.
152 KIAS	16,650 LB.	29.0 %MAC	5,050 FT.	A

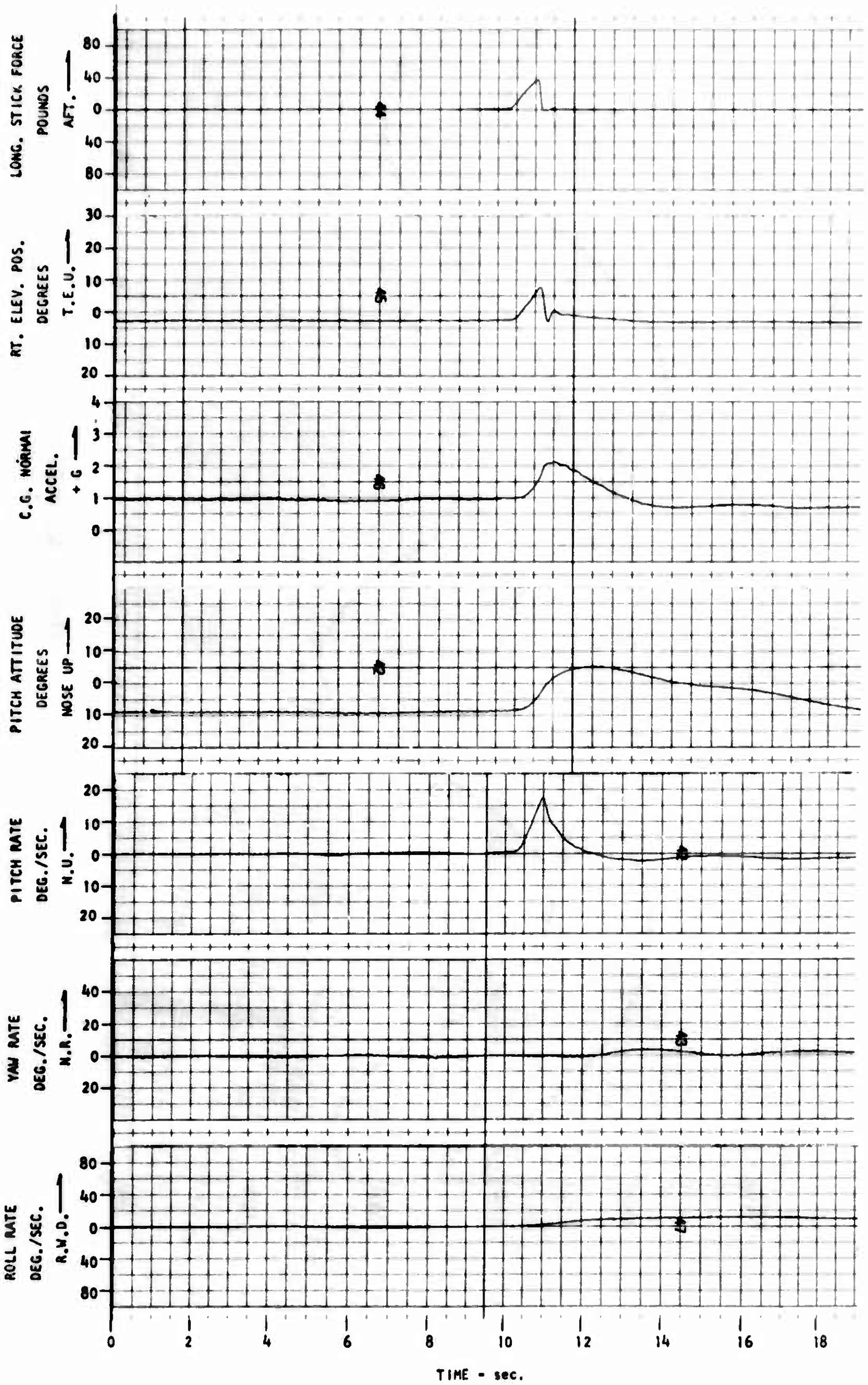


FIGURE No. 43

STATIC LATERAL-DIRECTIONAL STABILITY
QV-1D (PRE-PRODUCTION) USA S/N 67-18899
CRUISE CONFIGURATION

AVG CAL. AIRSPEED -KTS	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
160	16000	26.0	5140	A

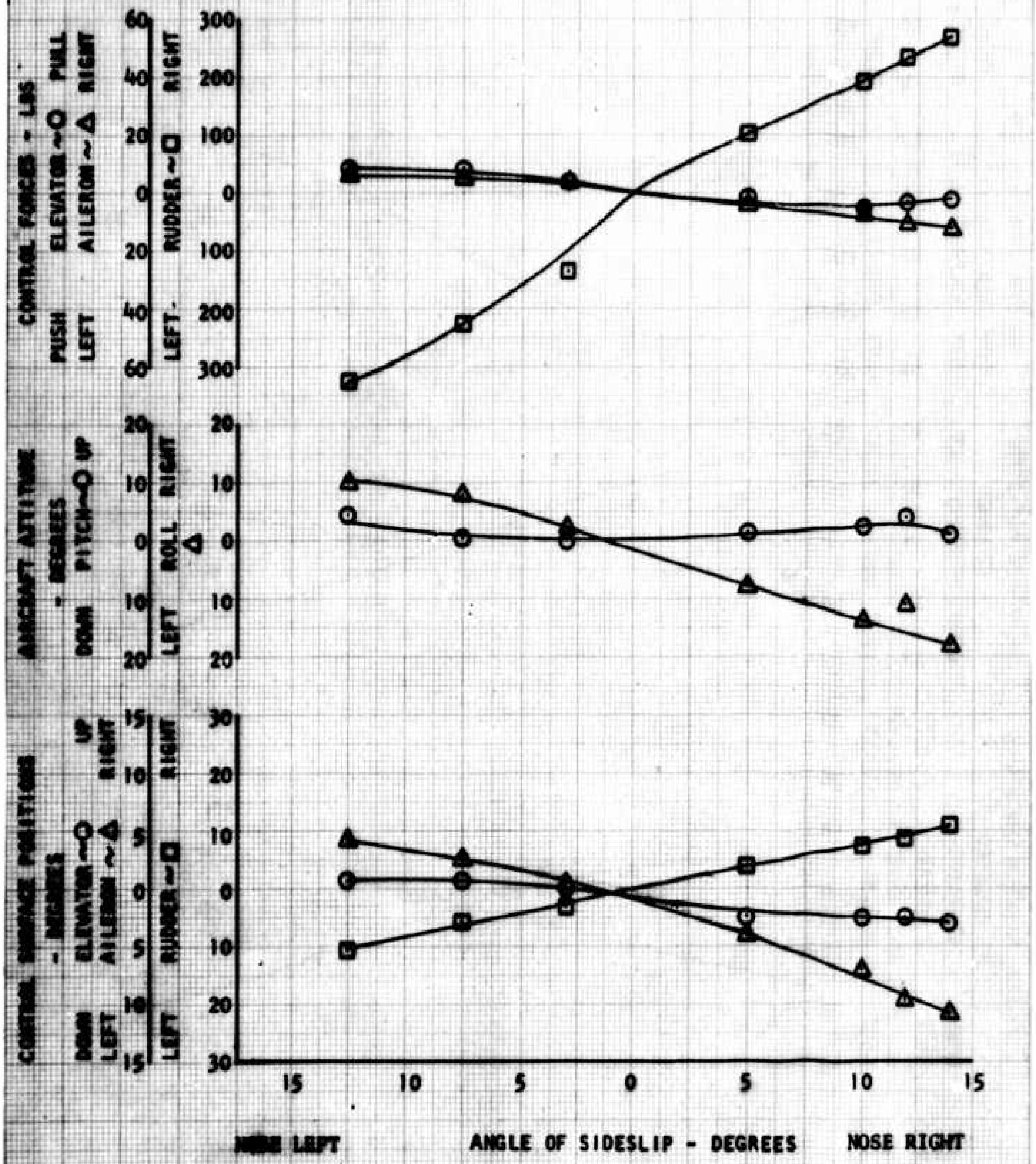


FIGURE No. 44
STATIC LATERAL-DIRECTIONAL STABILITY
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
CRUISE CONFIGURATION

AVG CAL. AIRSPEED -KTS	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
130	14200	25.0	5000	A

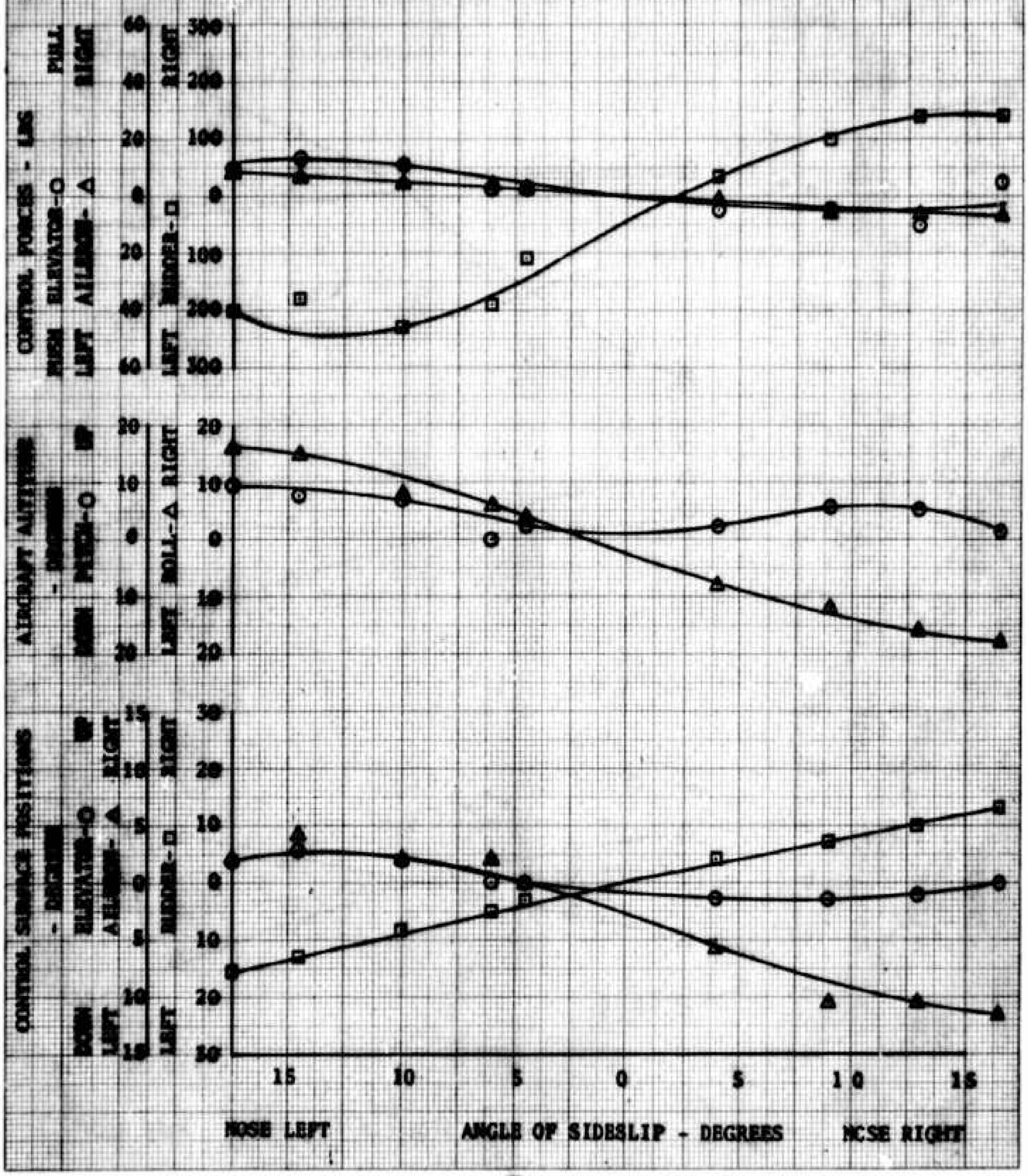


FIGURE No. 45
STATIC LATERAL-DIRECTIONAL STABILITY
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
POWER CONFIGURATION

AVG CAL. AIRSPEED -KTS	AVG. GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
211	16400	25.9	5040	A

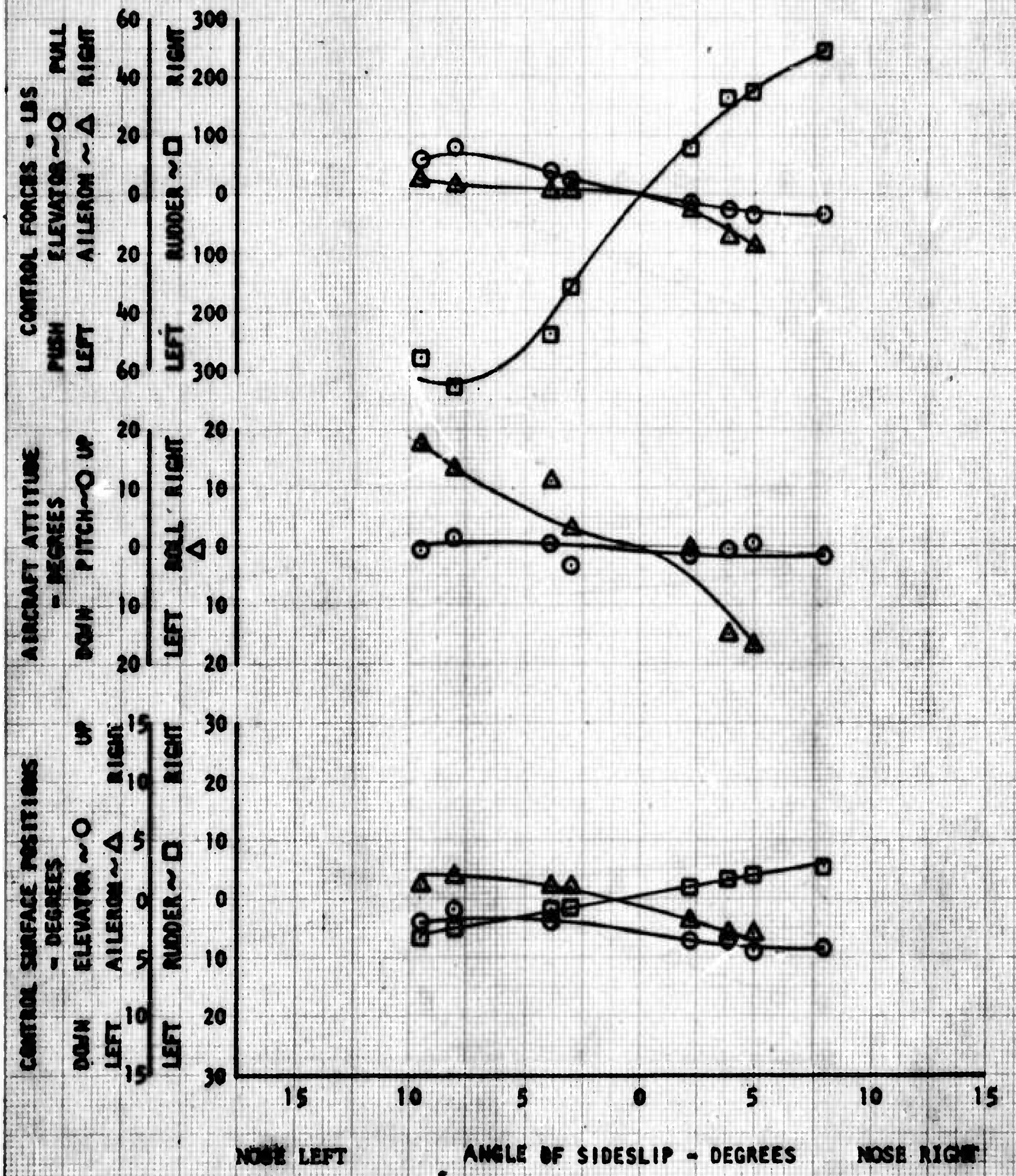


FIGURE No. 46
STATIC LATERAL-DIRECTIONAL STABILITY
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
LANDING CONFIGURATION

AVG CAL. AIRSPEED -KTS	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
110	14800	25.3	5000	A

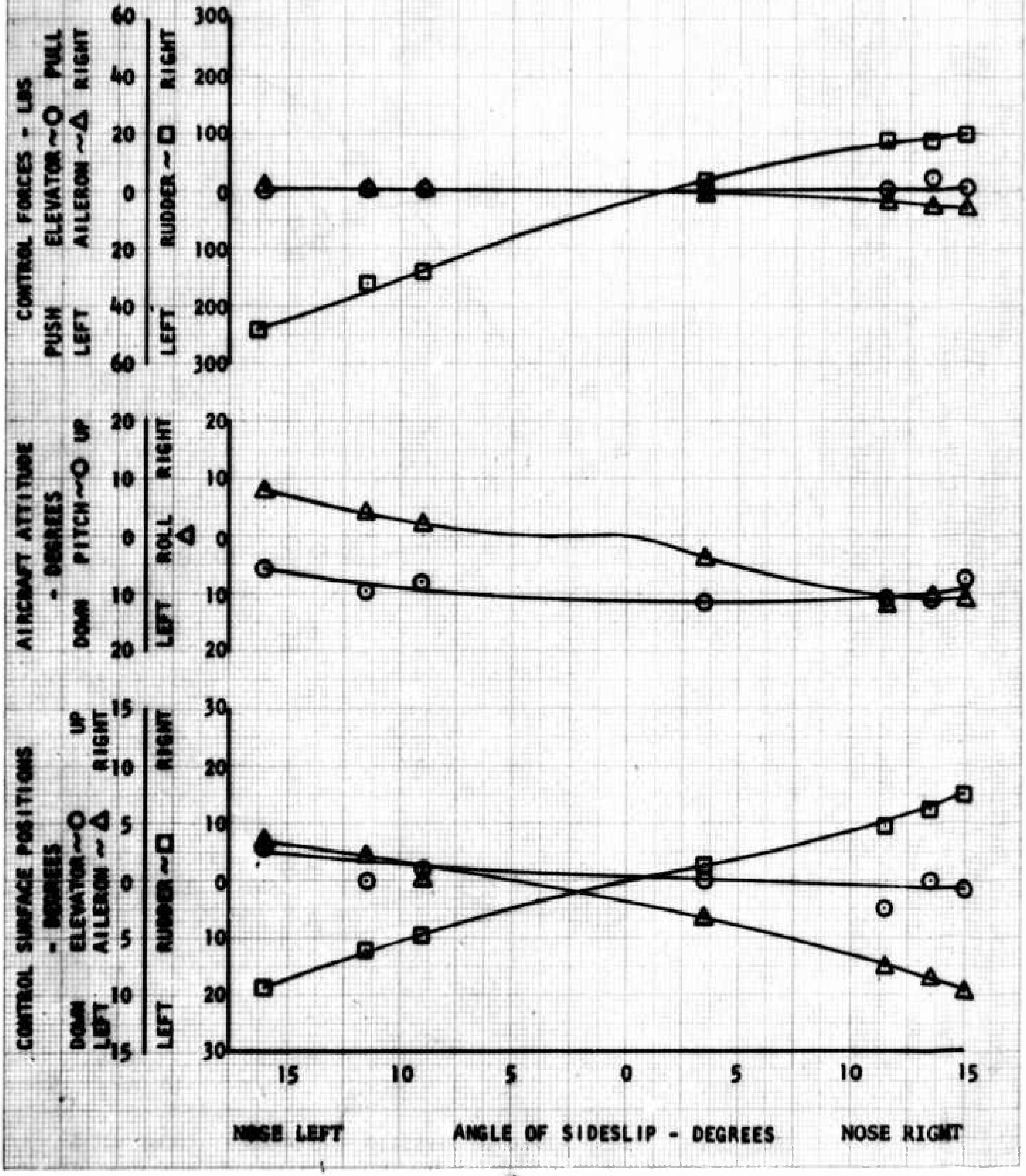


FIGURE No. 47
STATIC LATERAL-DIRECTIONAL STABILITY
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
POWER CONFIGURATION

AVG CAL. AIRSPEED -KTS	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
105	14500	25.0	4890	A

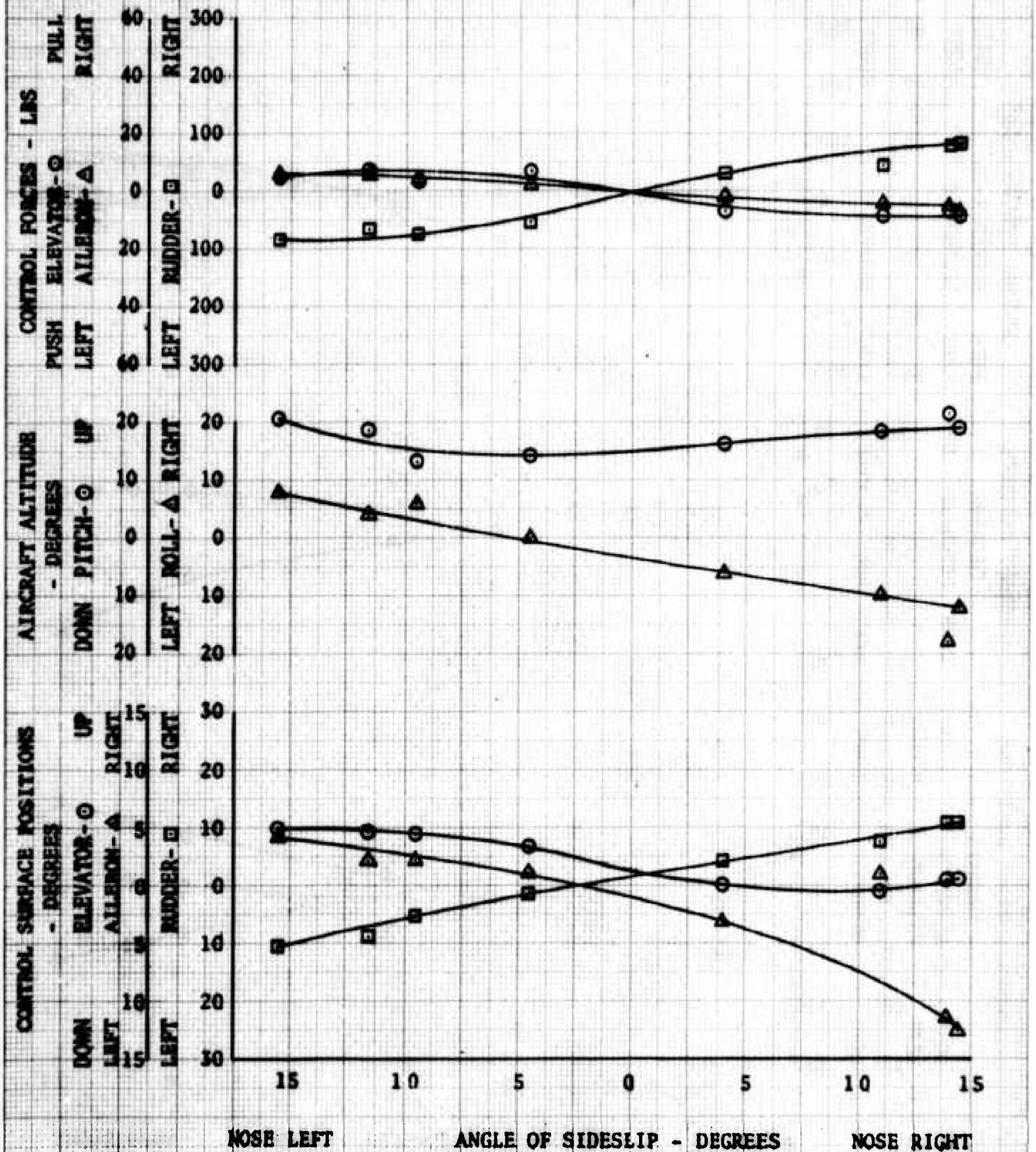


FIGURE No. 48
STATIC LATERAL-DIRECTIONAL STABILITY
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
WAVE-OFF CONFIGURATION

AVG CAL. AIRSPEED -KTS	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
106	14300	25.0	5150	A

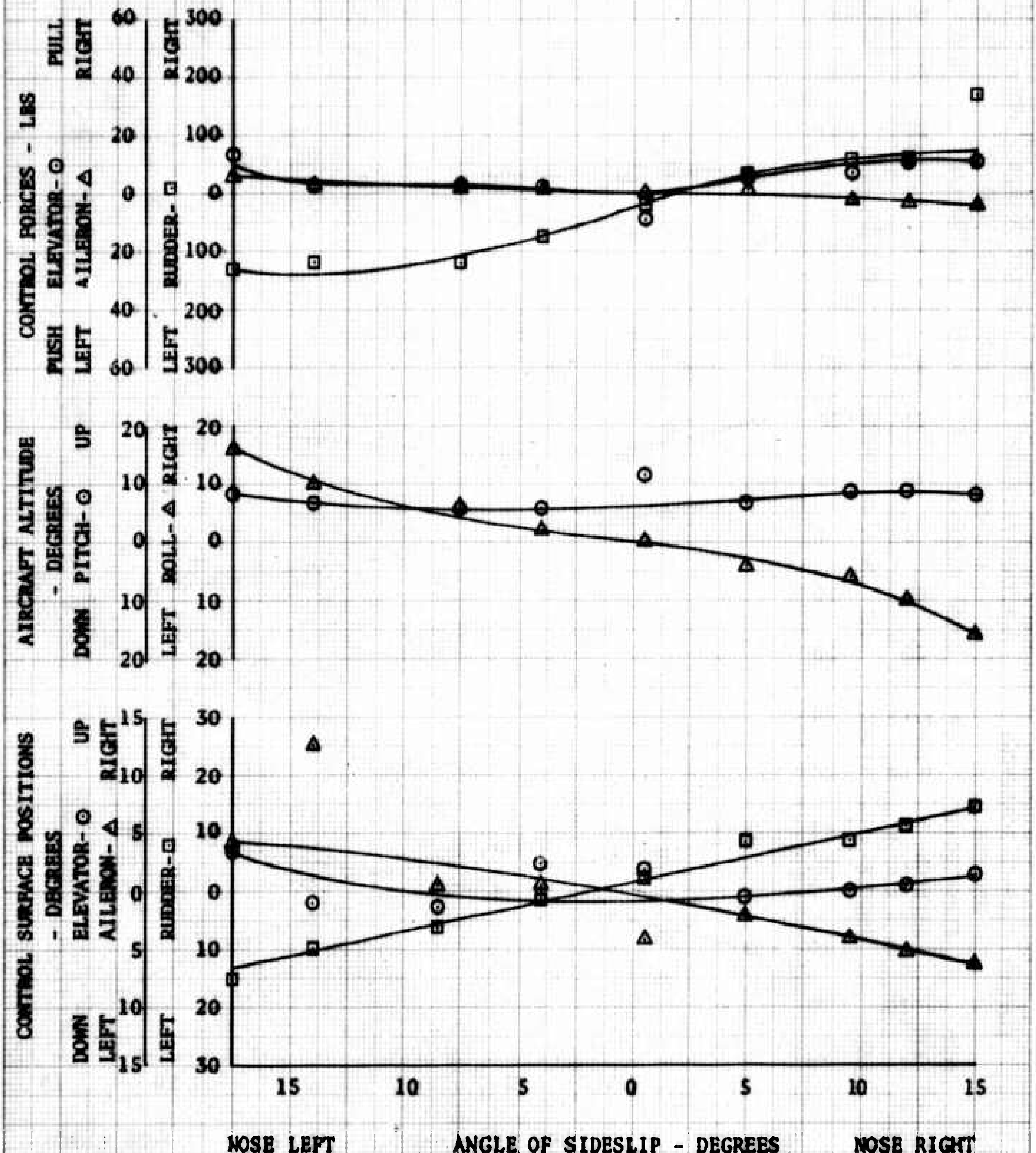


FIGURE No. 49
STATIC LATERAL-DIRECTIONAL STABILITY
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
POWER APPROACH CONFIGURATION

AVG CAL. AIRSPEED -KTS	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
95	15400	25.7	5030	A

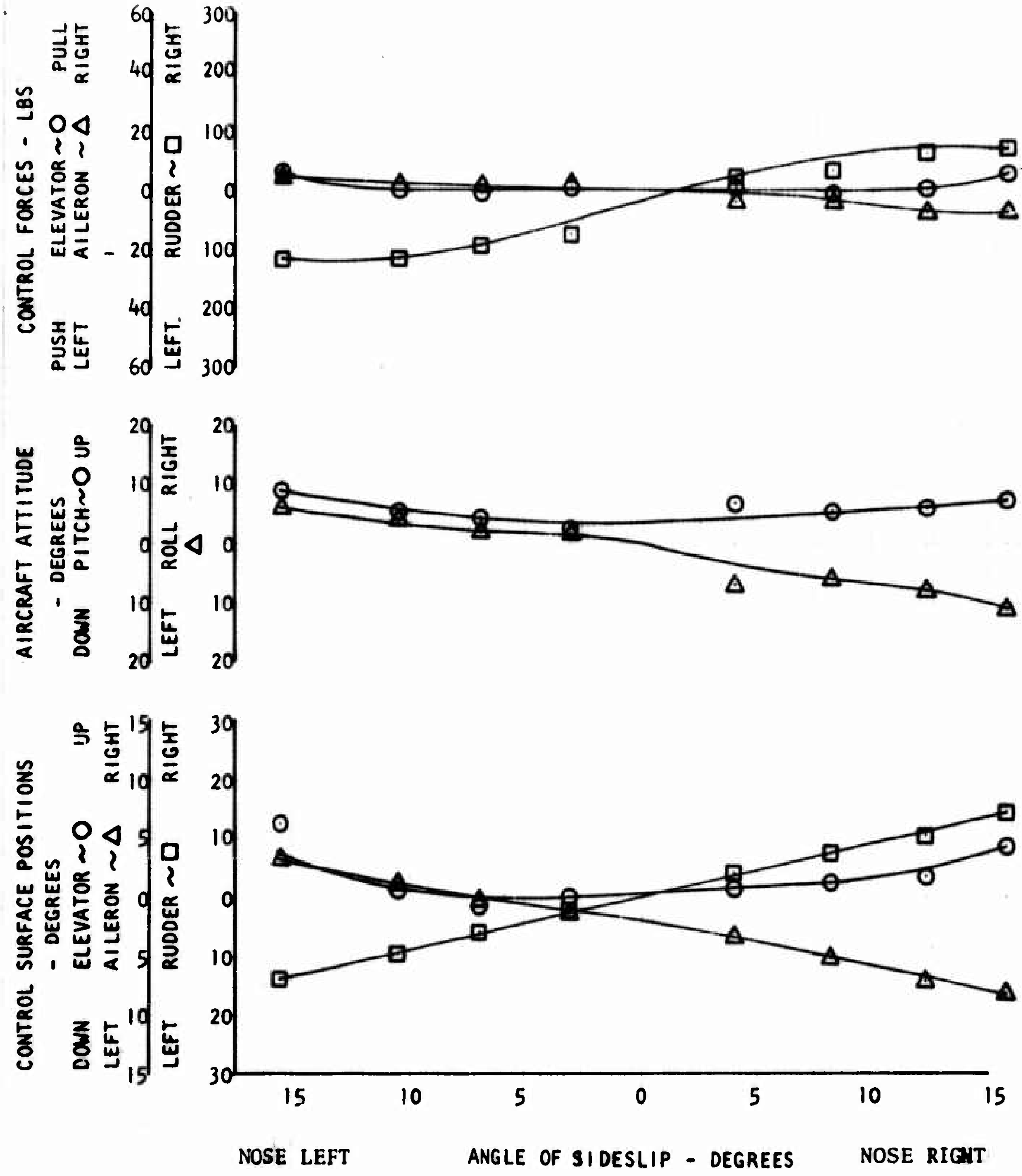


FIGURE No. 50
STATIC LATERAL-DIRECTIONAL STABILITY
OV-10 (PRE-PRODUCTION) USA S/N 67-18899
CRUISE CONFIGURATION

AVG CAL. AIRSPEED -KTS	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
160	15700	25.7	5300	C

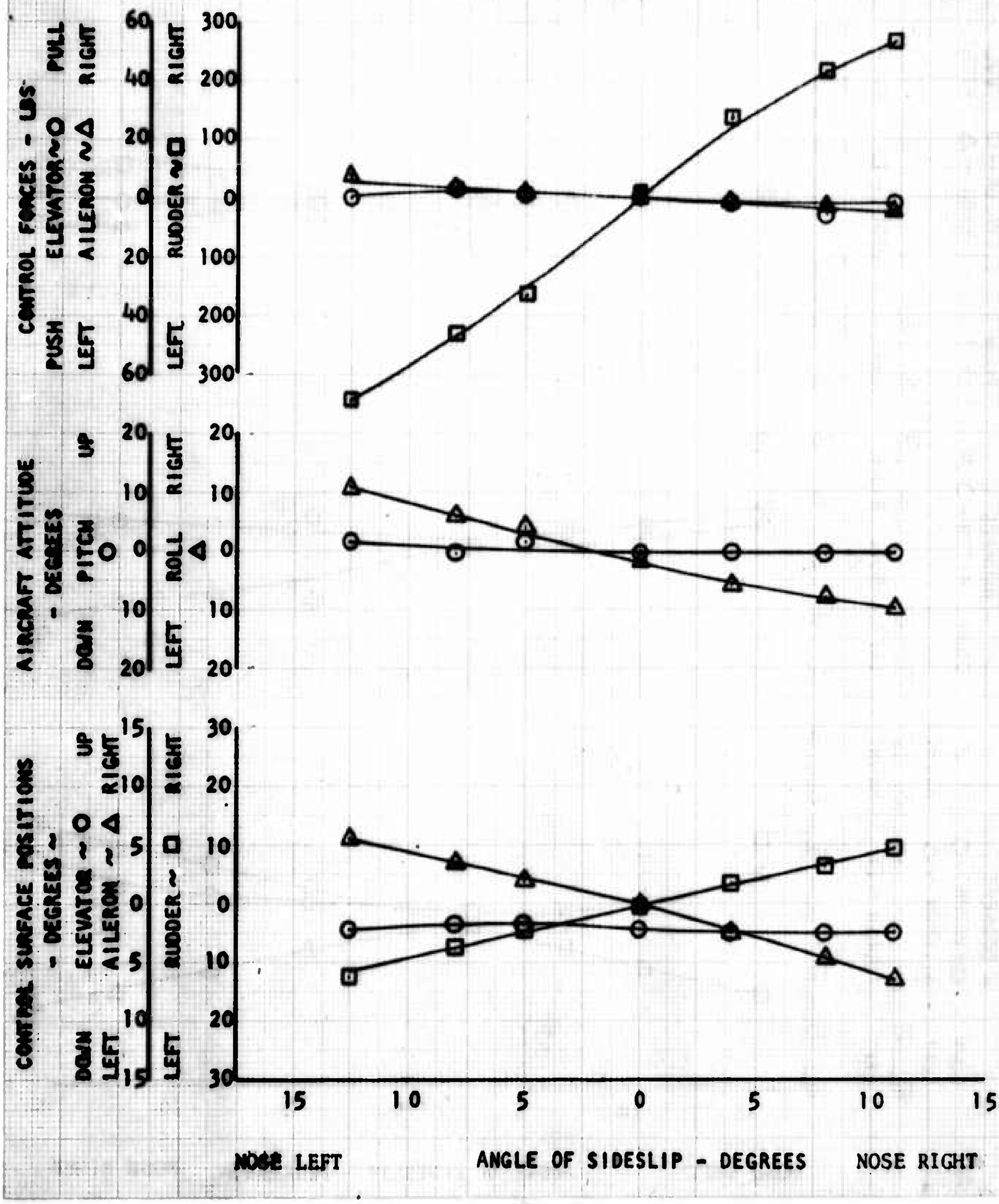


FIGURE No. 51
STATIC LATERAL-DIRECTIONAL STABILITY
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
CRUISE CONFIGURATION

AVG CAL. AIRSPEED -KTS	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
135	15000	25.6	5000	C

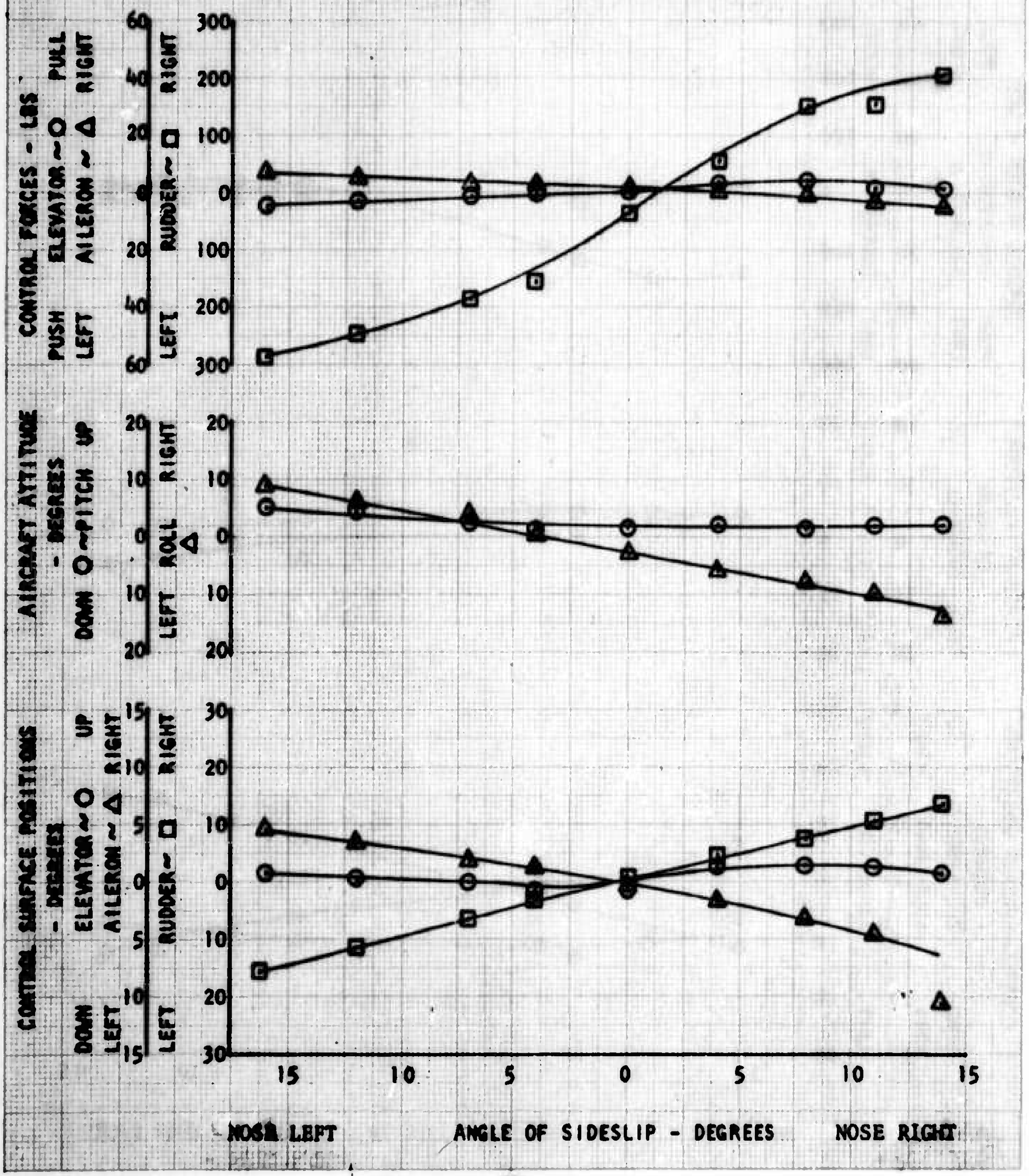


FIGURE No. 52
STATIC LATERAL-DIRECTIONAL STABILITY
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
POWER APPROACH CONFIGURATION

AVG CAL. AIRSPEED -KTS	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
92	15700	31.4	5900	C

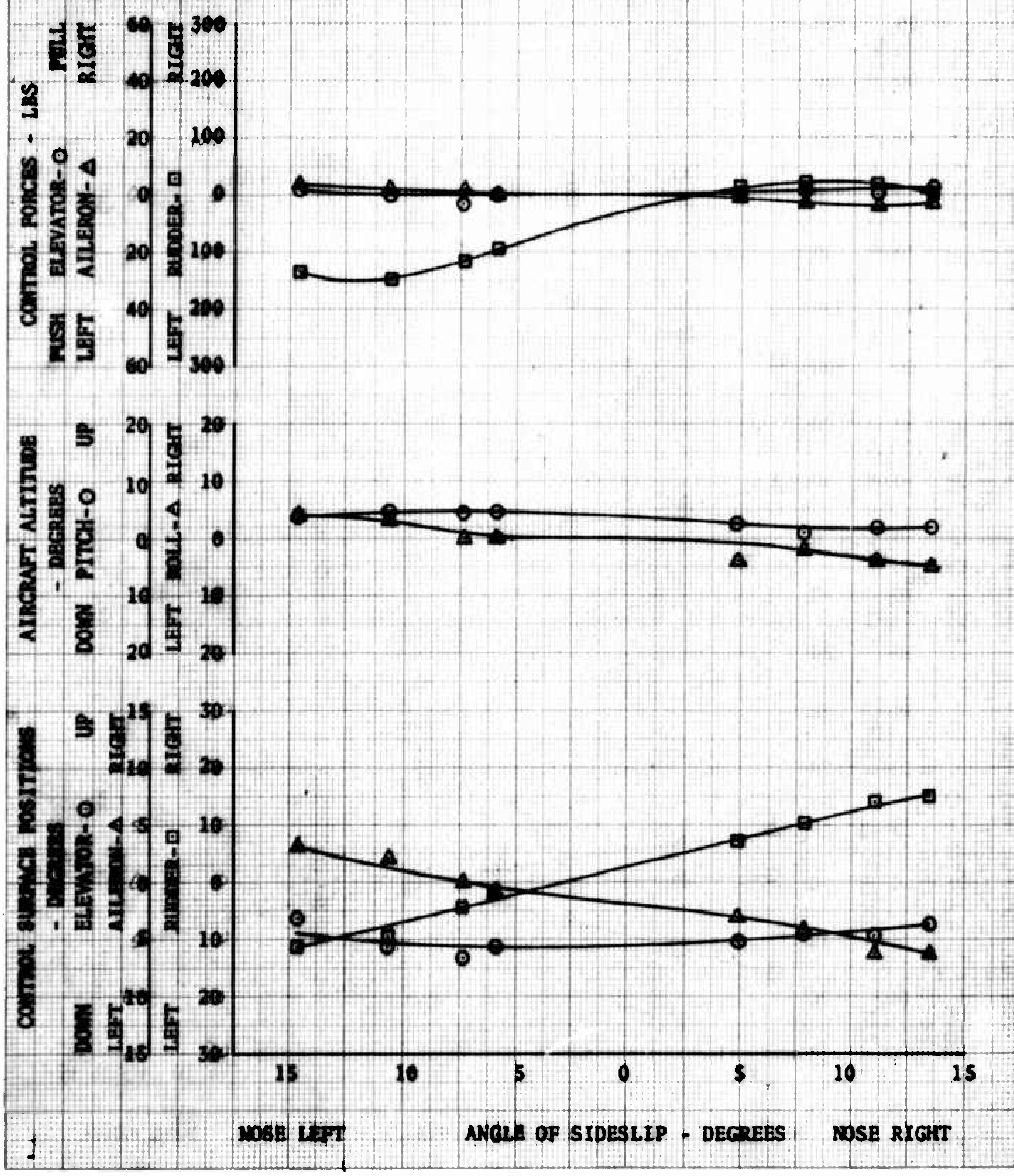


FIGURE No. 53
DYNAMIC LATERAL - DIRECTIONAL STABILITY
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
CONFIGURATION A

SYM	AIRCRAFT CONFIG.	AVG EQUIV. AIRSPEED -KTS	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE FT	MANEUVER
○	CR	153	15900	24.4	5100	L SIDESLIP RLSE
□	CR	138	15750	24.1	5250	R SIDESLIP RLSE
□	CR	128	15850	24.2	5250	L SIDESLIP RLSE
△	PA	88	15250	24.0	5000	L SIDESLIP RLSE
◗	L	116	14800	23.9	5700	R SIDESLIP RLSE
◗	L	116	14750	23.9	3850	L SIDESLIP RLSE

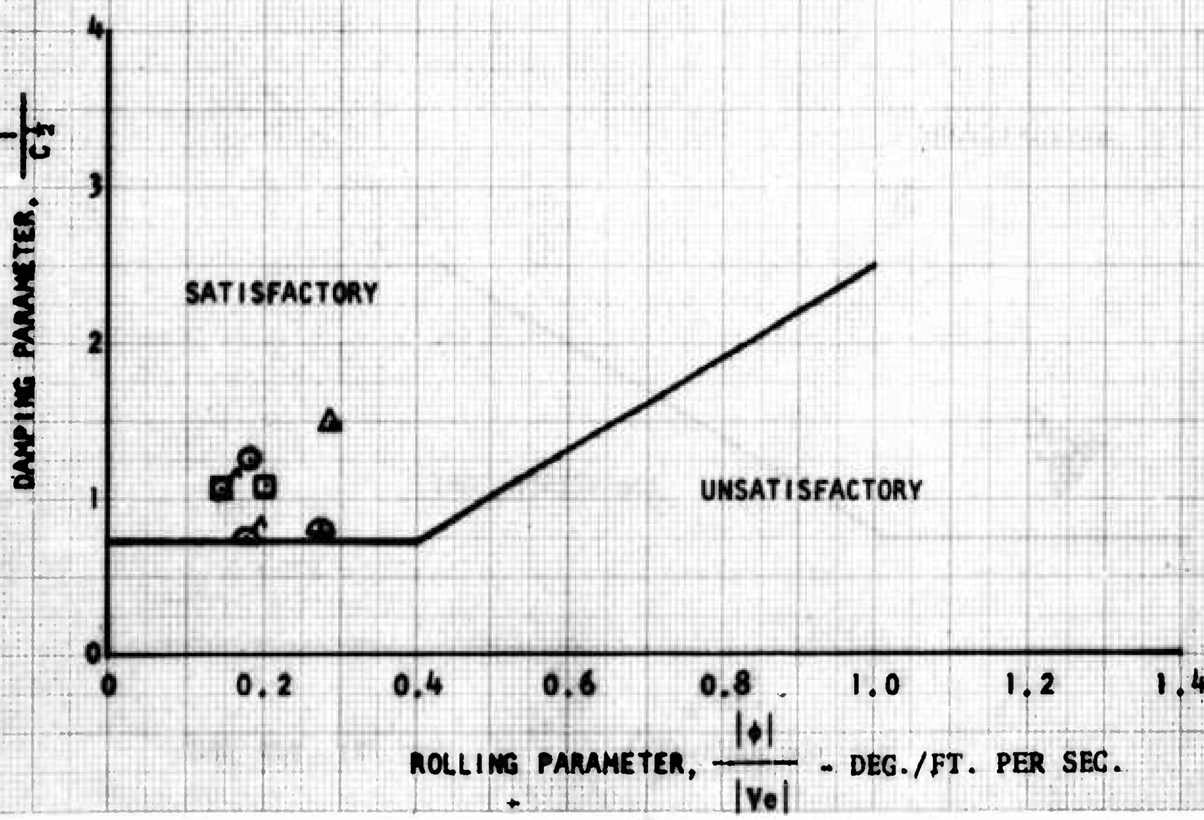


FIGURE No. 54
DYNAMIC LATERAL - DIRECTIONAL STABILITY
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
CONFIGURATION C

SYM	AIRCRAFT CONFIG.	AVG EQUIV. AIRSPEED -KTS	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE FT	MANEUVER
◁	P	212	15250	25.6	5200	R SIDESLIP RLSE
◁	P	212	15250	25.6	5250	L SIDESLIP RLSE
○	CR	155	15050	25.4	5100	R SIDESLIP RLSE
○	CR	167	15200	25.5	5200	L SIDESLIP RLSE
□	CR	136	14900	25.4	5100	R SIDESLIP RLSE
□	CR	135	14950	25.4	5000	L SIDESLIP RLSE
△	PA	95	14700	25.2	4900	R SIDESLIP RLSE
△	PA	93	14700	25.2	4850	L SIDESLIP RLSE
⌓	L	119	14700	25.2	5050	R SIDESLIP RLSE
⌓	L	118	14700	25.2	5000	L SIDESLIP RLSE

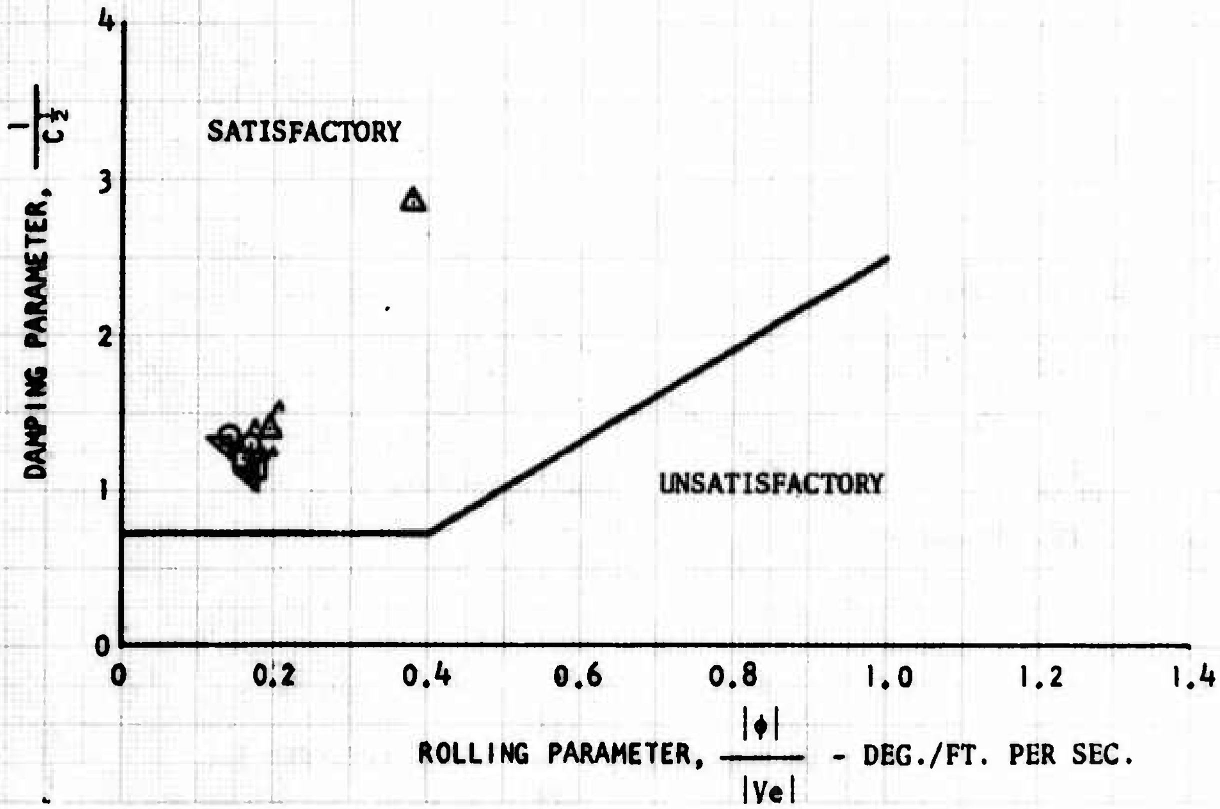


FIGURE No. 55
LATERAL CONTROL
OV-1D (PRE-PRODUCTION) USA S/N 67-18899

SYM	AIRCRAFT CONFIG.	AVG GROSS WEIGHT LB.	AVG C.G. %MAC	AVG PRESSURE ALTITUDE FT.	STORE CONFIG.
□	PA	16650	24.9	2600	A
○	CR	17200	24.8	5100	A

NOTE: FLAGGED SYMBOL DENOTES RIGHT ROLL, UNFLAGGED LEFT ROLL.

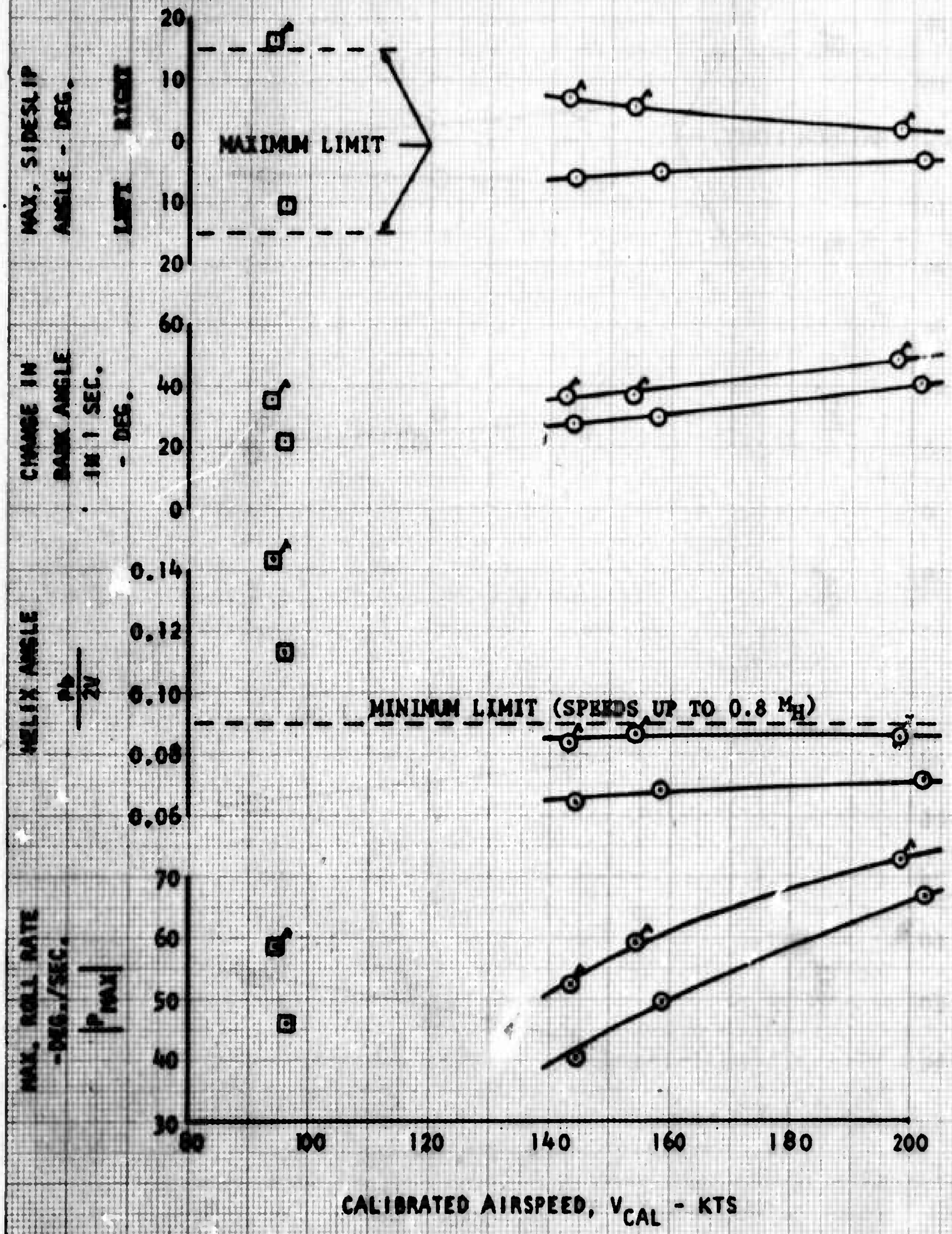


FIGURE No. 56

LATERAL CONTROL

OV-1D (PRE-PRODUCTION) USA S/N 67-18899

SYM	AIRCRAFT CONFIG.	AVG GROSS WEIGHT LB.	AVG C.G. %MAC	AVG PRESSURE ALTITUDE FT.	STORE CONFIG.
□	PA	14750	25.4	4900	C
○	CR	15750	29.0	4900	C

NOTE: FLAGGED SYMBOL DENOTES RIGHT ROLL, UNFLAGGED LEFT ROLL.

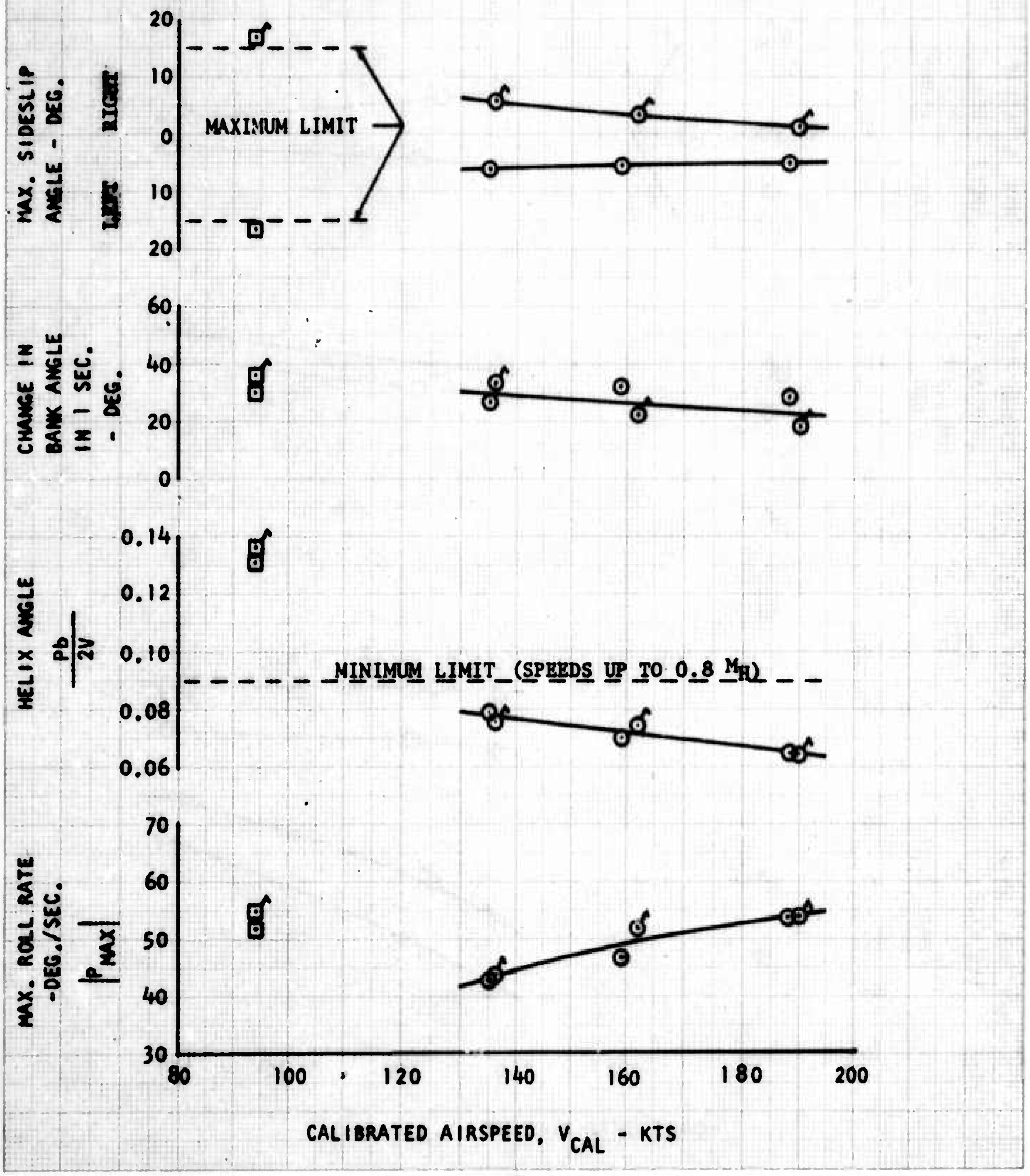


FIGURE No. 57
MANEUVERING FLIGHT CHARACTERISTICS
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
POWER CONFIGURATION, LEFT WIND-UP TURN

AVG CAL. AIRSPEED -KTS	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
199.4	16800	29.2	5700	A

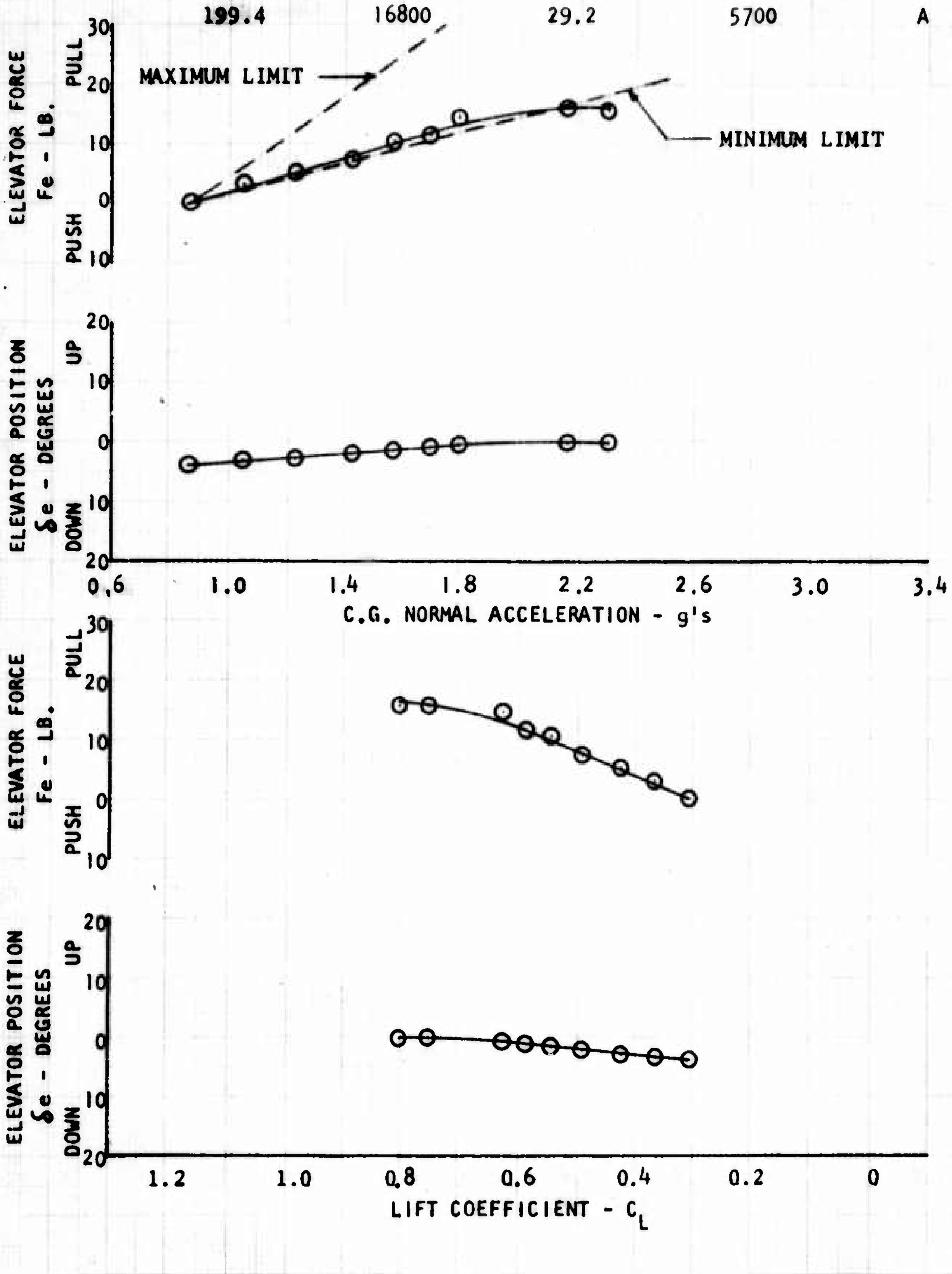


FIGURE No. 58
MANEUVERING FLIGHT CHARACTERISTICS
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
POWER COMP[illegible]ATION, [illegible]

AVG CAL. AIRSPEED -KTS	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
207.5	16760	29.2	5800	A

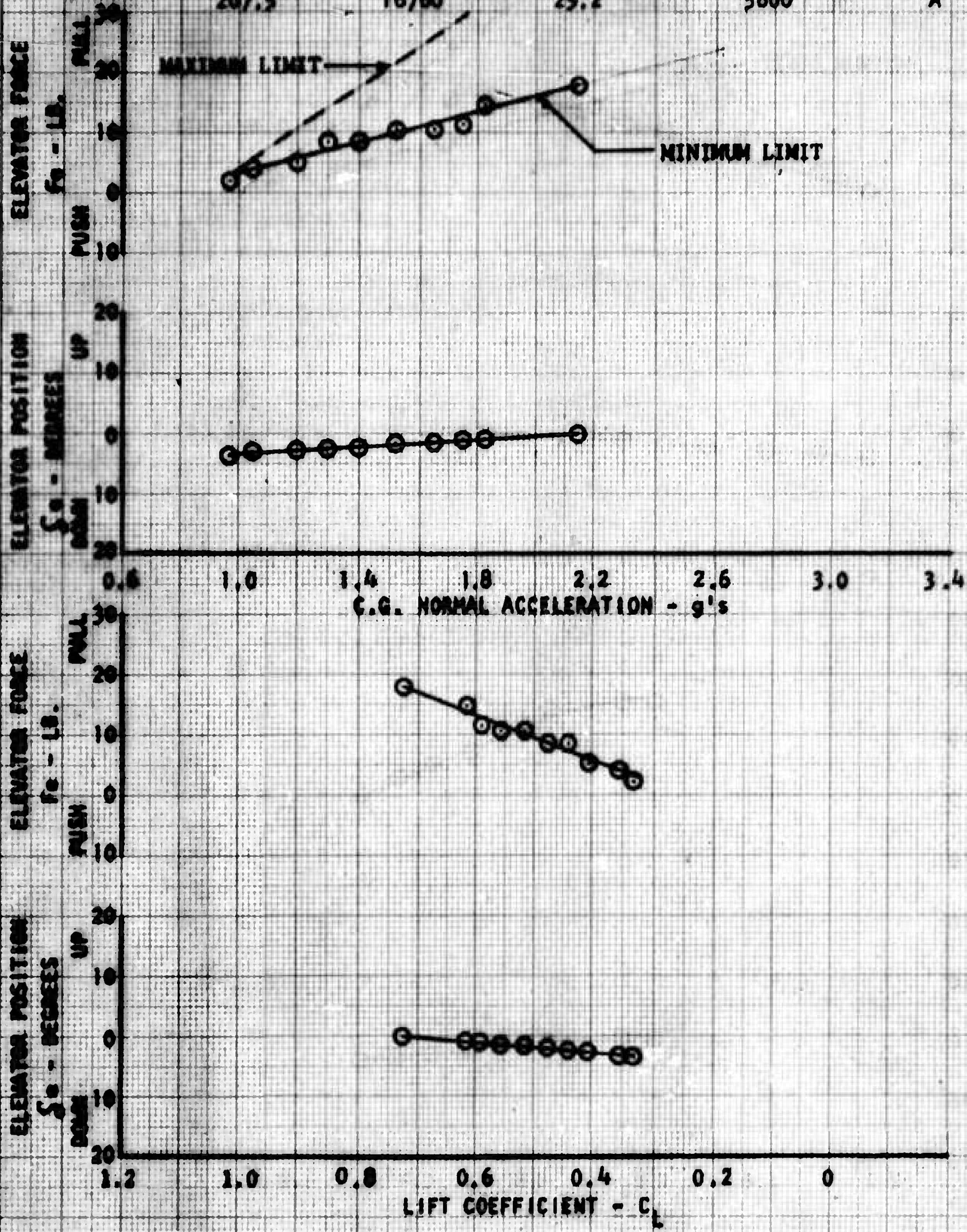


FIGURE No. 59

MANEUVERING FLIGHT CHARACTERISTICS

OV-1D (PRE-PRODUCTION) USA S/N 67-18899

POWER CONFIGURATION, SYMMETRICAL PULL-UP

AVG CAL. AIRSPEED -KTS	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
190	16700	29.2	6100	A

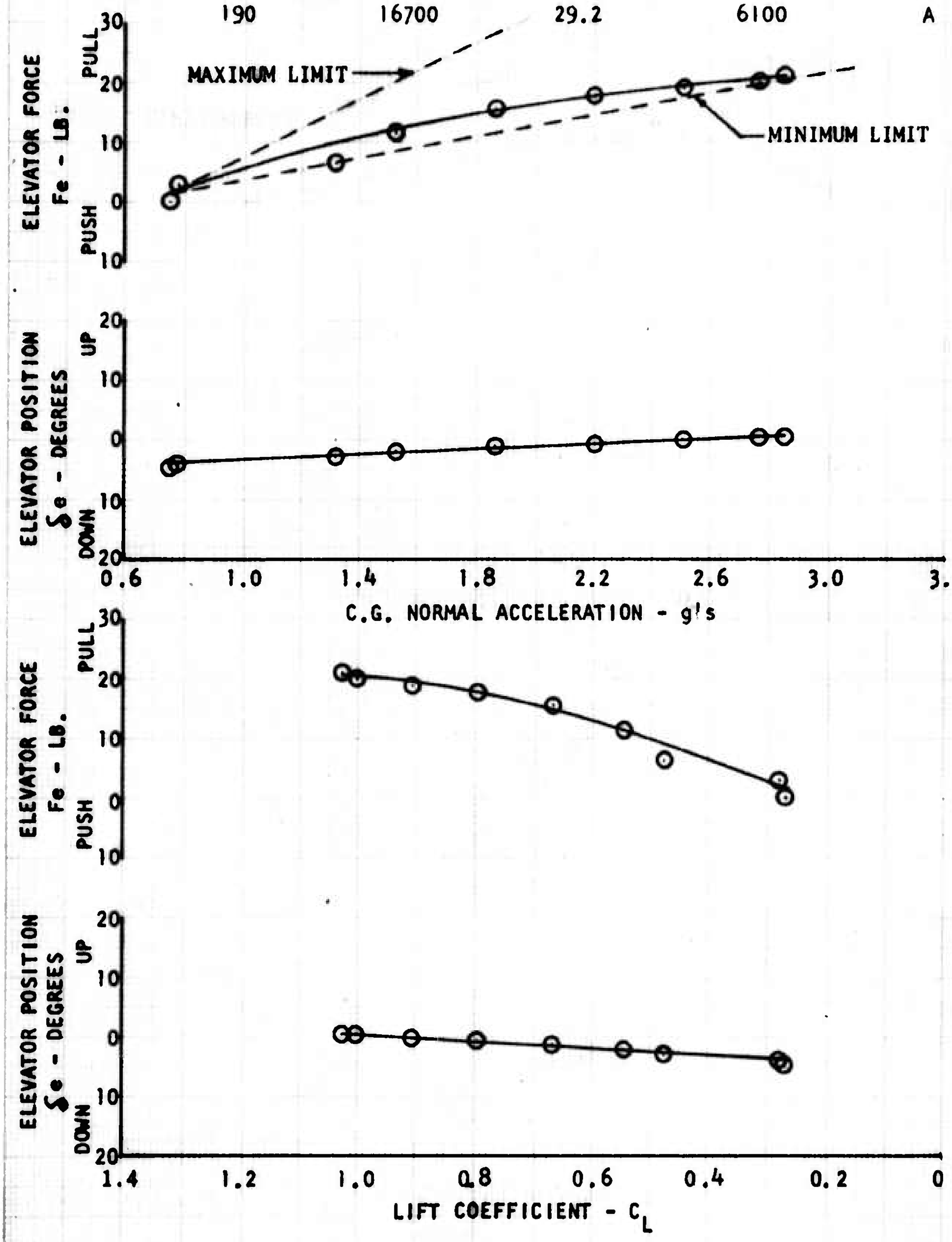


FIGURE No. 60

MANEUVERING FLIGHT CHARACTERISTICS

OV-1D (PRE-PRODUCTION) USA S/N 67-18899

DIVE CONFIGURATION, RT. WIND-UP TURN

AVG CAL. AIRSPEED -KTS	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
310	15200	28.7	6500	A

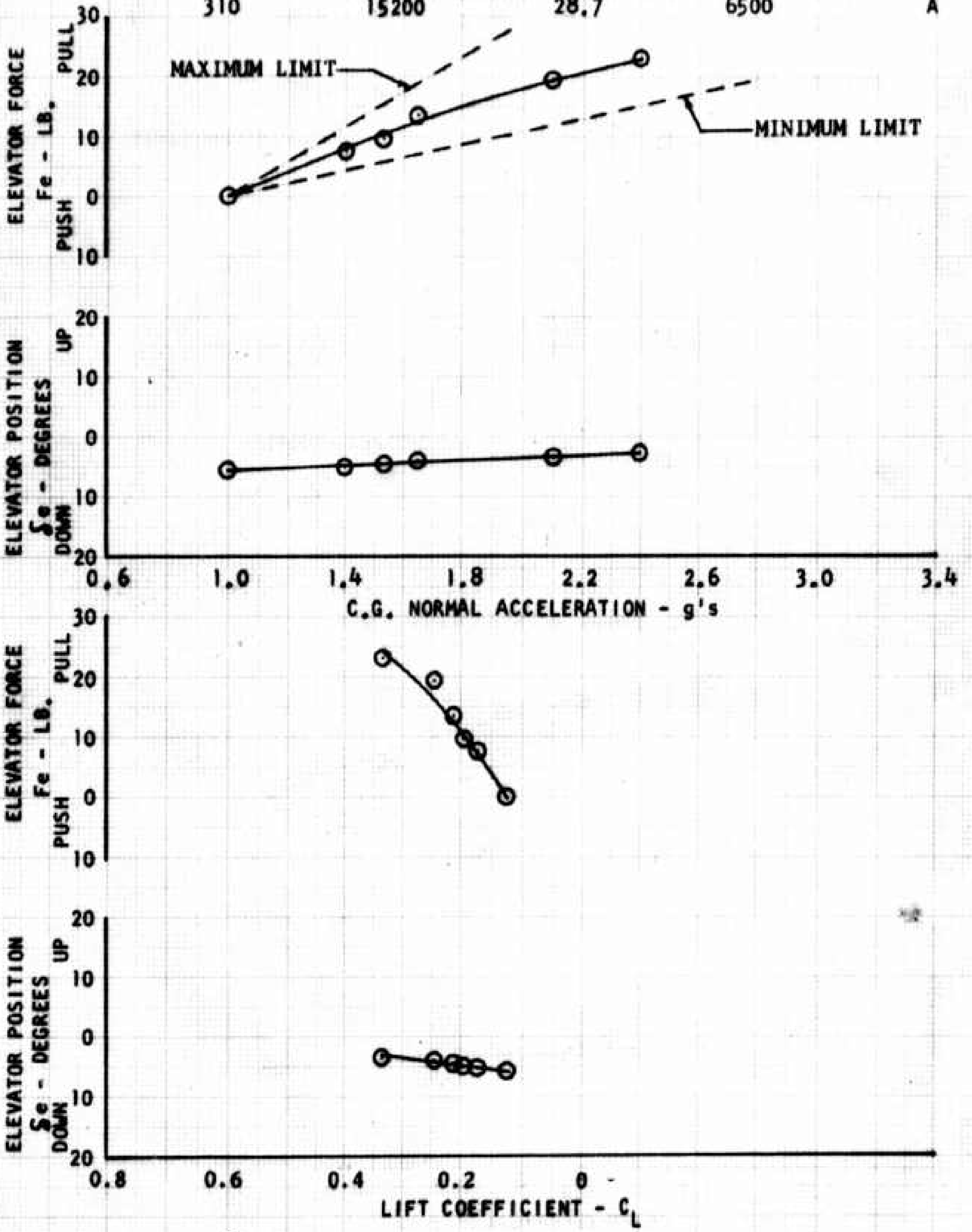


FIGURE No. 61
MANEUVERING FLIGHT CHARACTERISTICS
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
POWER APPROACH CONFIGURATION, RT. WIND-UP TURN

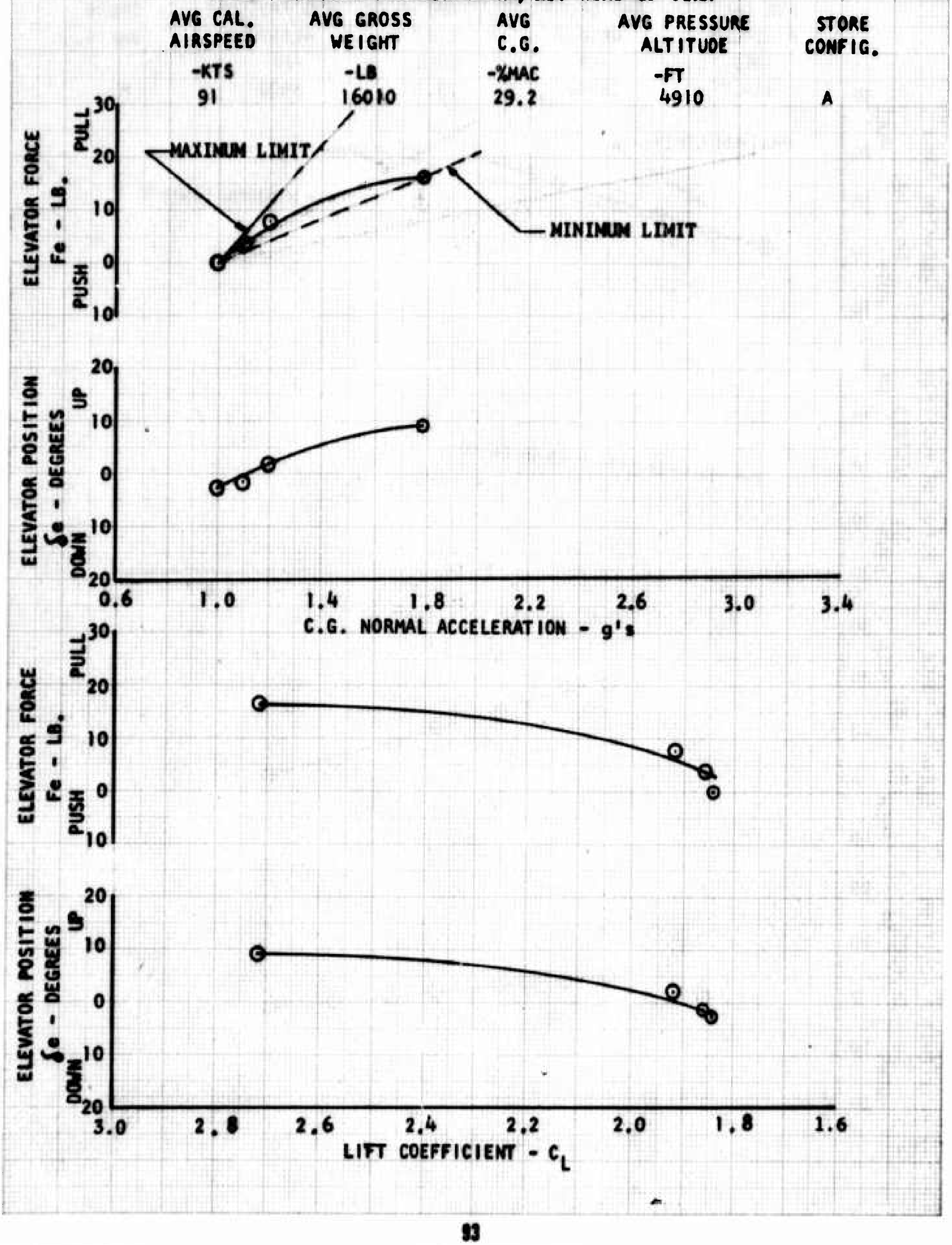


FIGURE No. 62
MANEUVERING FLIGHT CHARACTERISTICS
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
CRUISE CONFIGURATION, RT. WIND-UP TURN

AVG CAL. AIRSPEED -KTS	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
154.3	16400	29.1	5900	A

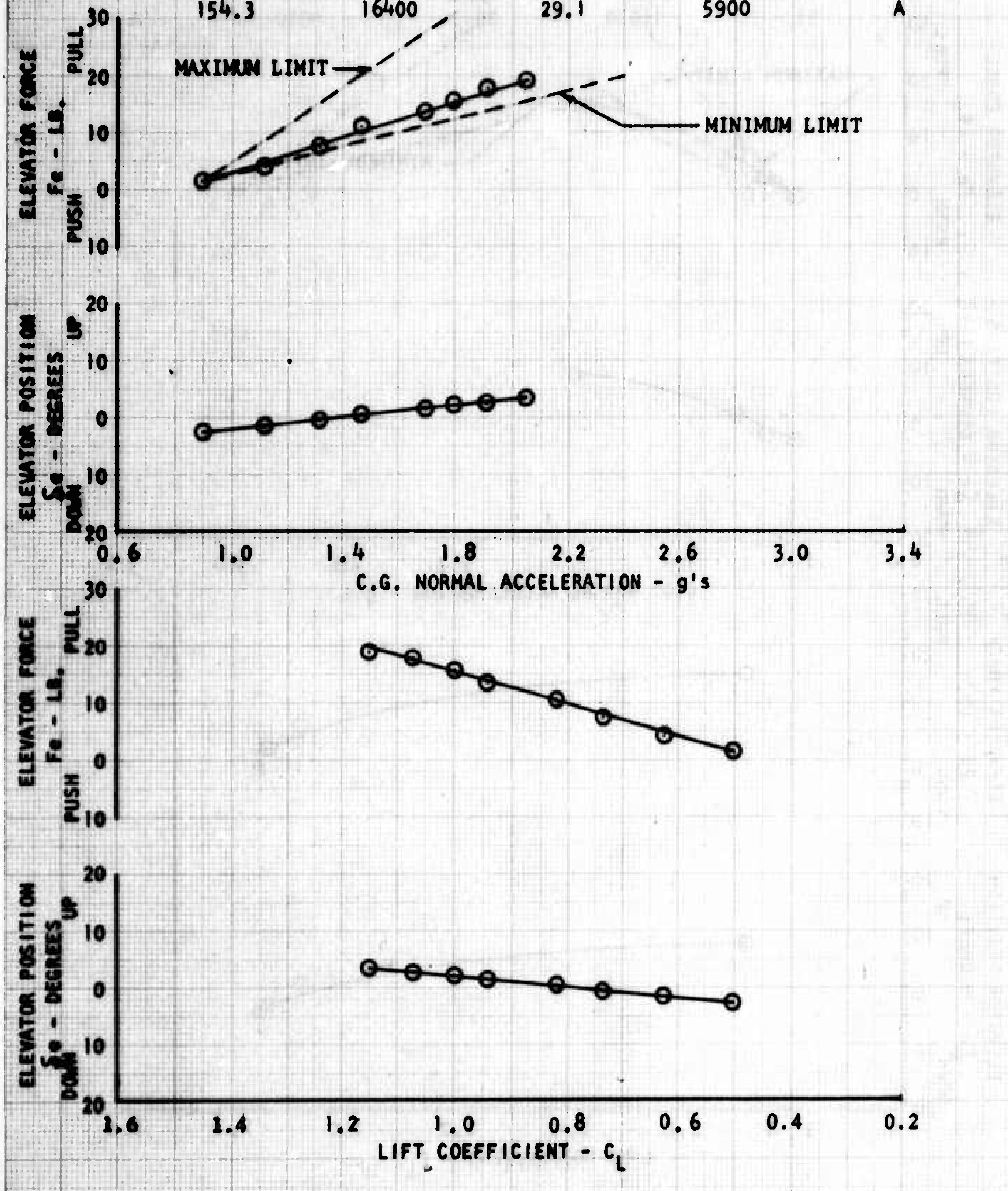


FIGURE No. 63
MANEUVERING FLIGHT CHARACTERISTICS
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
DIVE CONFIGURATION, LEFT WIND-UP TURN

AVG CAL. AIRSPEED -KTS	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
319	16050	29.6	6900	C

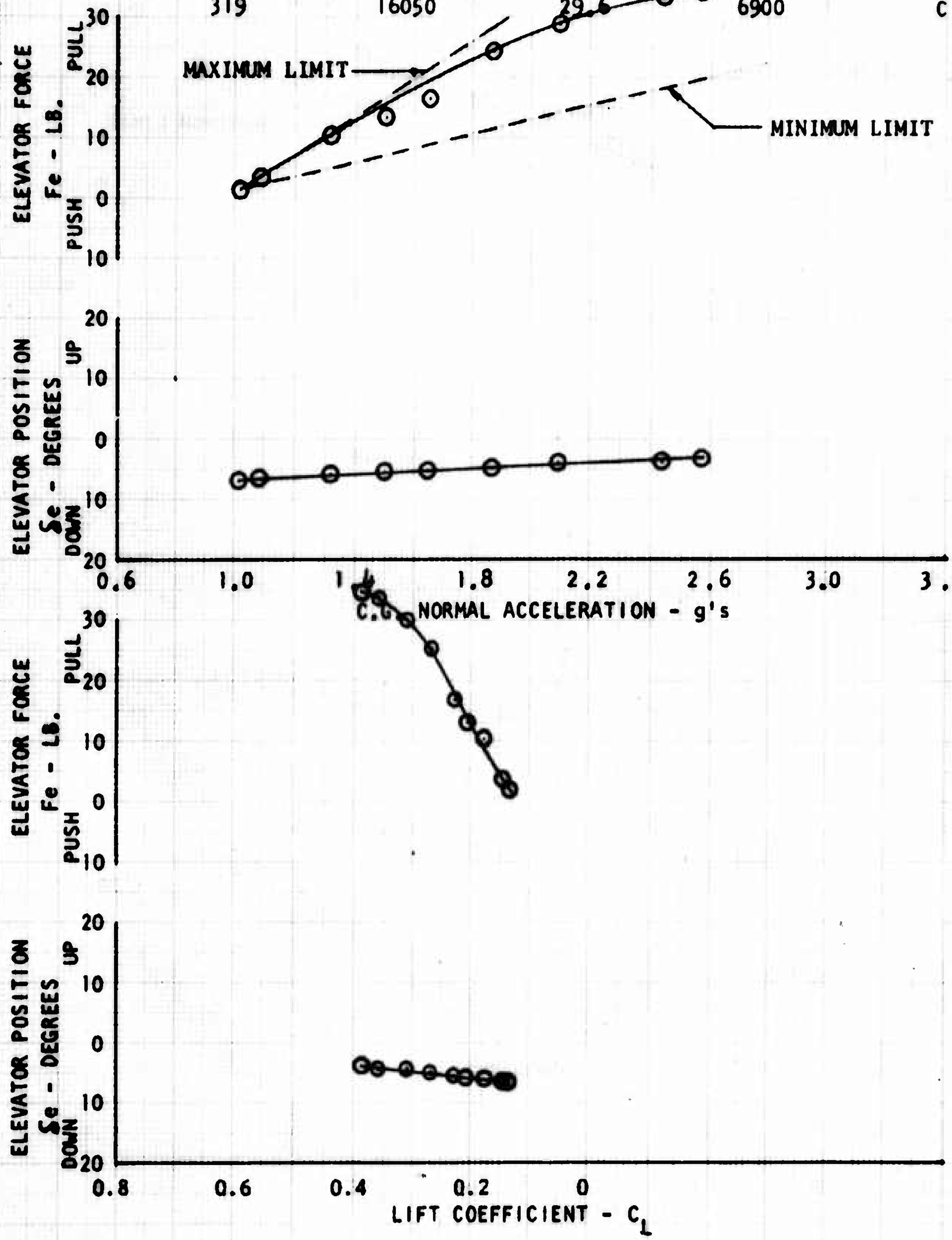


FIGURE No. 64

MANEUVERING FLIGHT CHARACTERISTICS

OV-1D (PRE-PRODUCTION) USA S/N 67-18899

DIVE CONFIGURATION, [illegible] WIND-UP TURN

AVG CAL. AIRSPEED -KTS	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
318	15800	29.8	6790	C

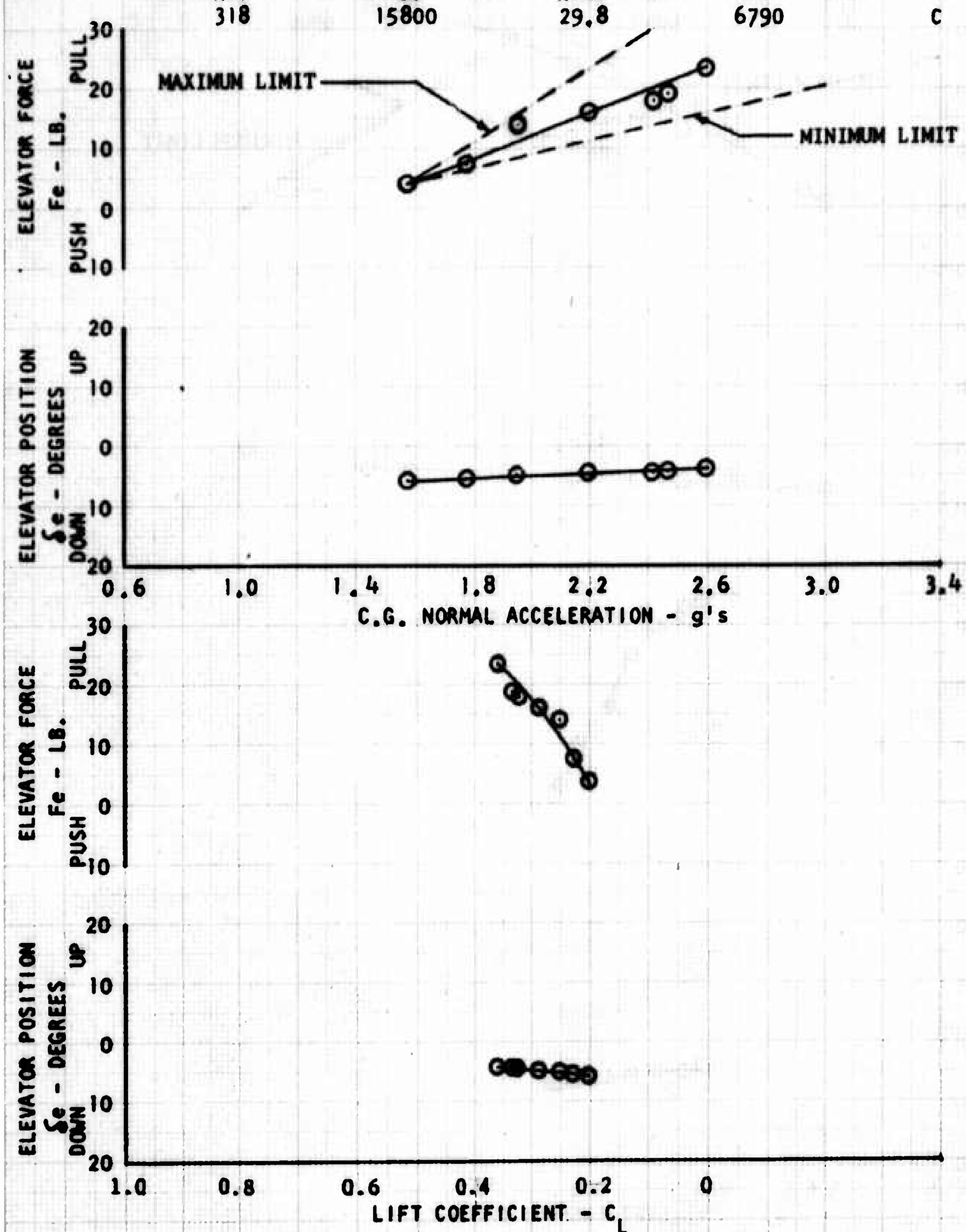


FIGURE No. 65
MANEUVERING FLIGHT CHARACTERISTICS
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
DIVE CONFIGURATION, SYMMETRICAL PULL-UP

AVG. CAL. AIRSPEED -KTS	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
265	15000	31.6	3800	C

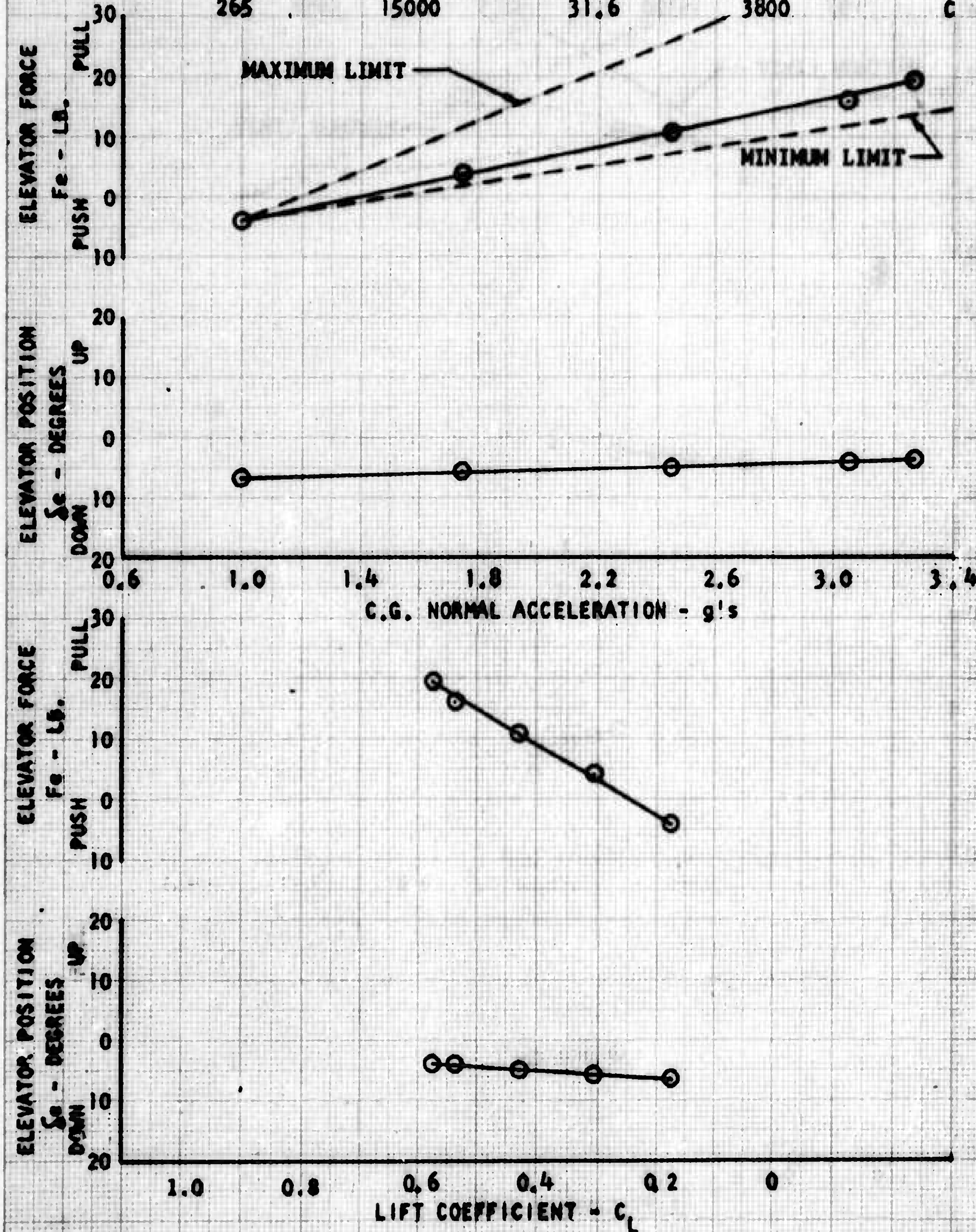


FIGURE No. 66
MANEUVERING FLIGHT CHARACTERISTICS
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
POWER CONFIGURATION, RT. WIND-UP TURN

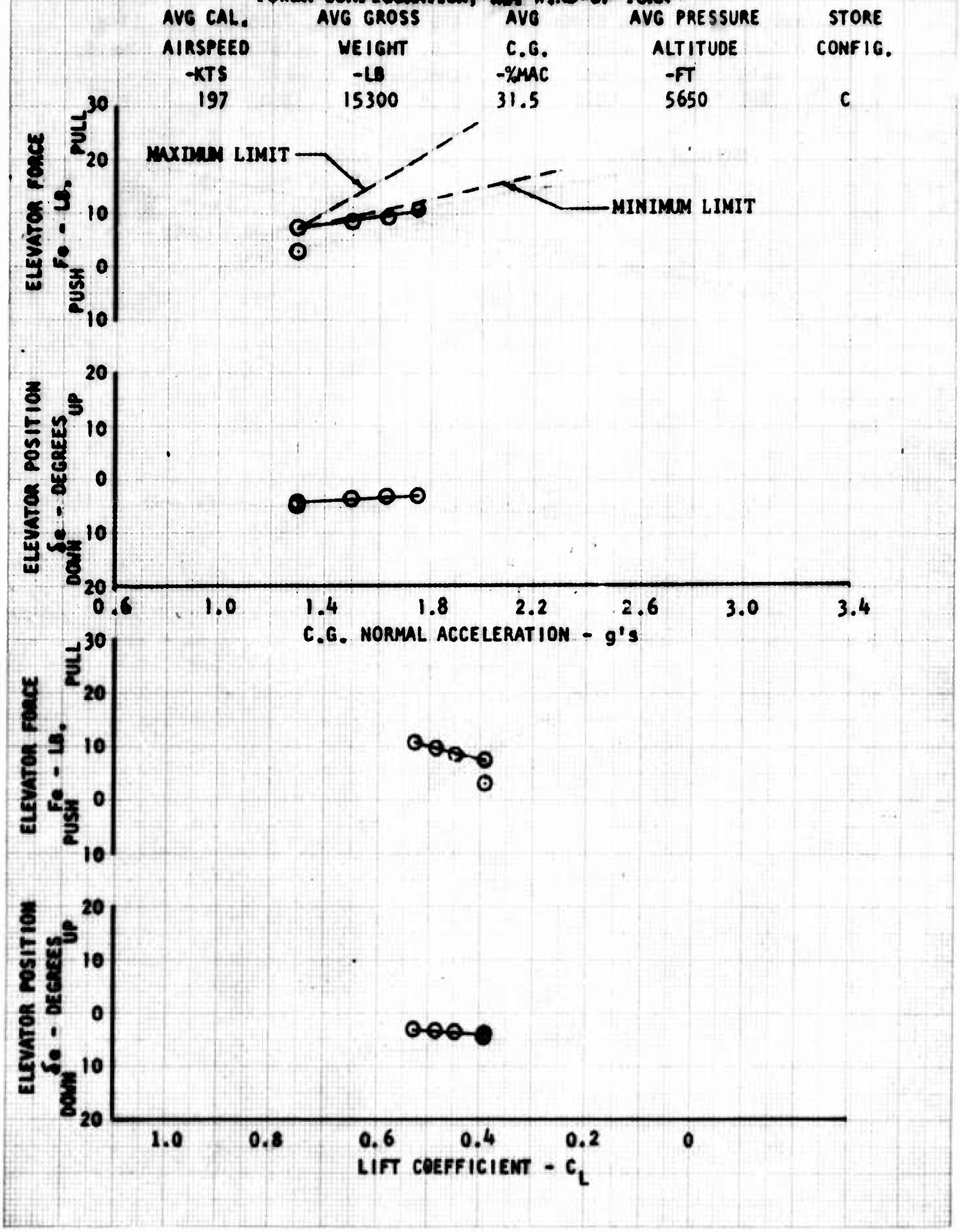
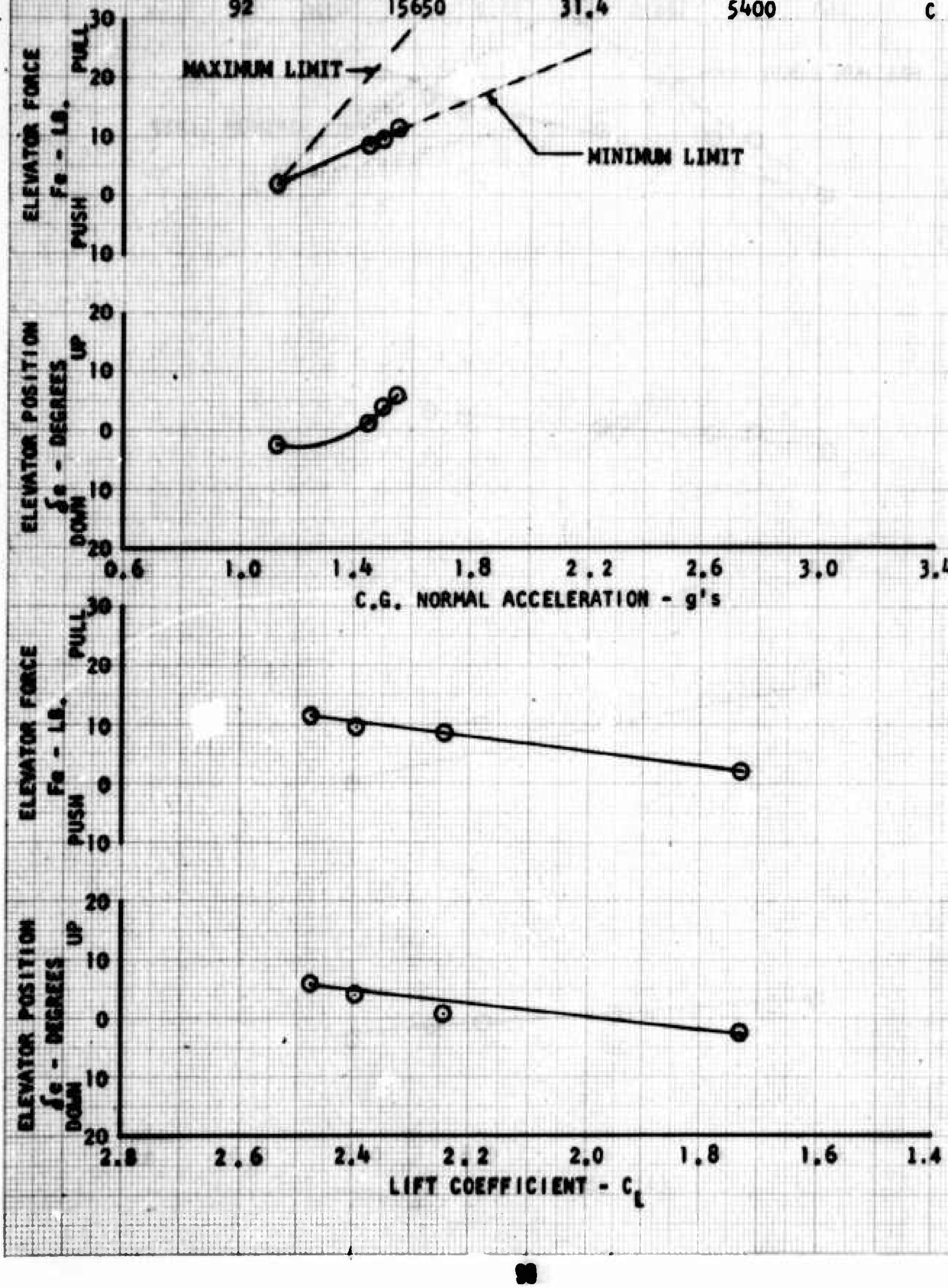


FIGURE No. 67
MANEUVERING FLIGHT CHARACTERISTICS
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
POWER APPROACH CONFIGURATION, RT. WIND-UP TURN

AVG CAL. AIRSPEED -KTS	AVG GROSS WEIGHT -LB	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT	STORE CONFIG.
92	15650	31.4	5400	C



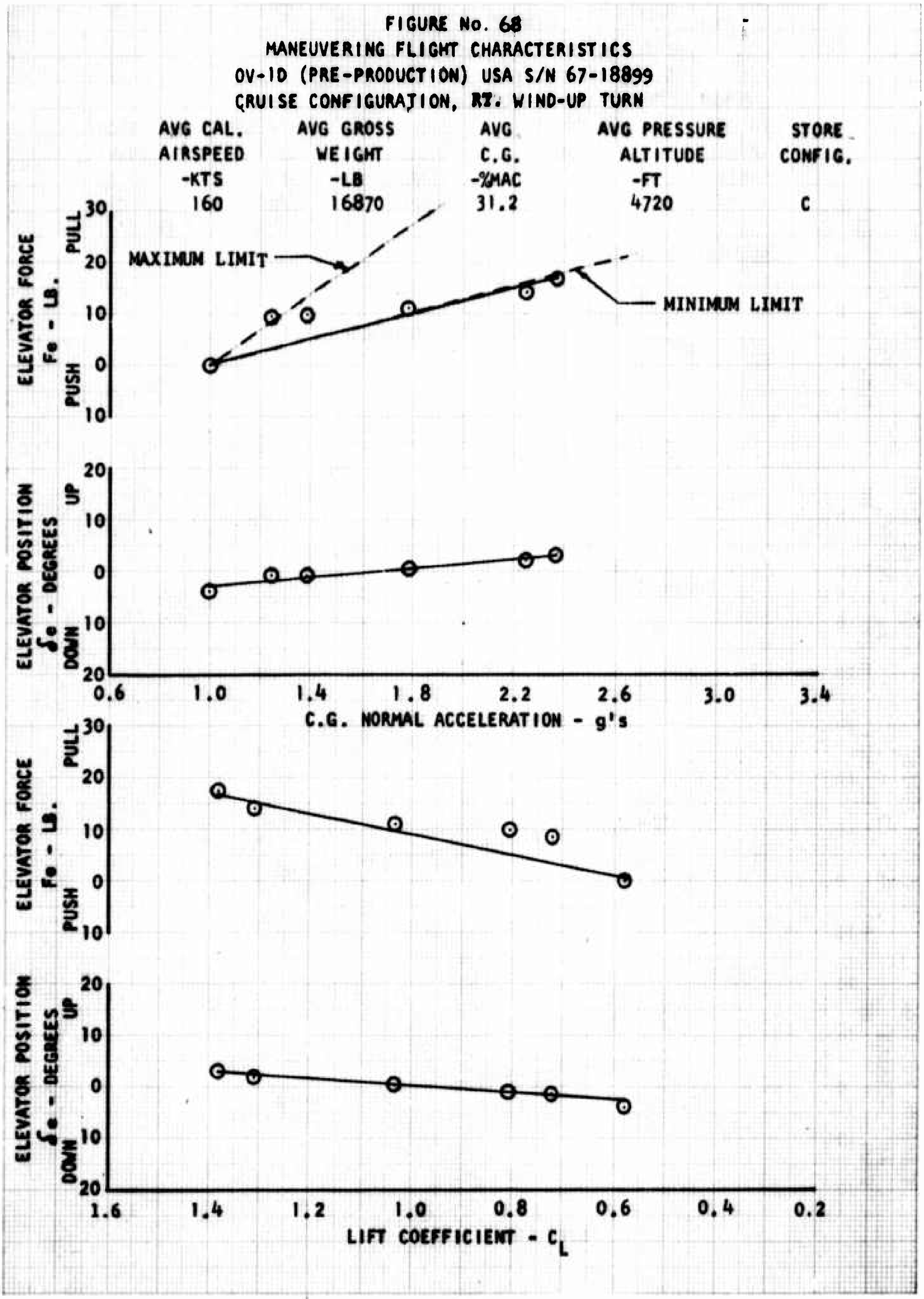


FIGURE No. 68
MANEUVERING FLIGHT CHARACTERISTICS
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
CRUISE CONFIGURATION, RT. WIND-UP TURN
AVG CAL. AIRSPEED -KTS 160
AVG GROSS WEIGHT -LB 16870
AVG C.G. -%MAC 31.2
AVG PRESSURE ALTITUDE -FT 4720
STORE CONFIG. C
MAXIMUM LIMIT
MINIMUM LIMIT
ELEVATOR FORCE Fe - LB.
PUSH
PULL
ELEVATOR POSITION δe - DEGREES
DOWN
UP
C.G. NORMAL ACCELERATION - g's
LIFT COEFFICIENT - C_L

FIGURE No. 69
TRIMMABILITY
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
CONFIGURATION A

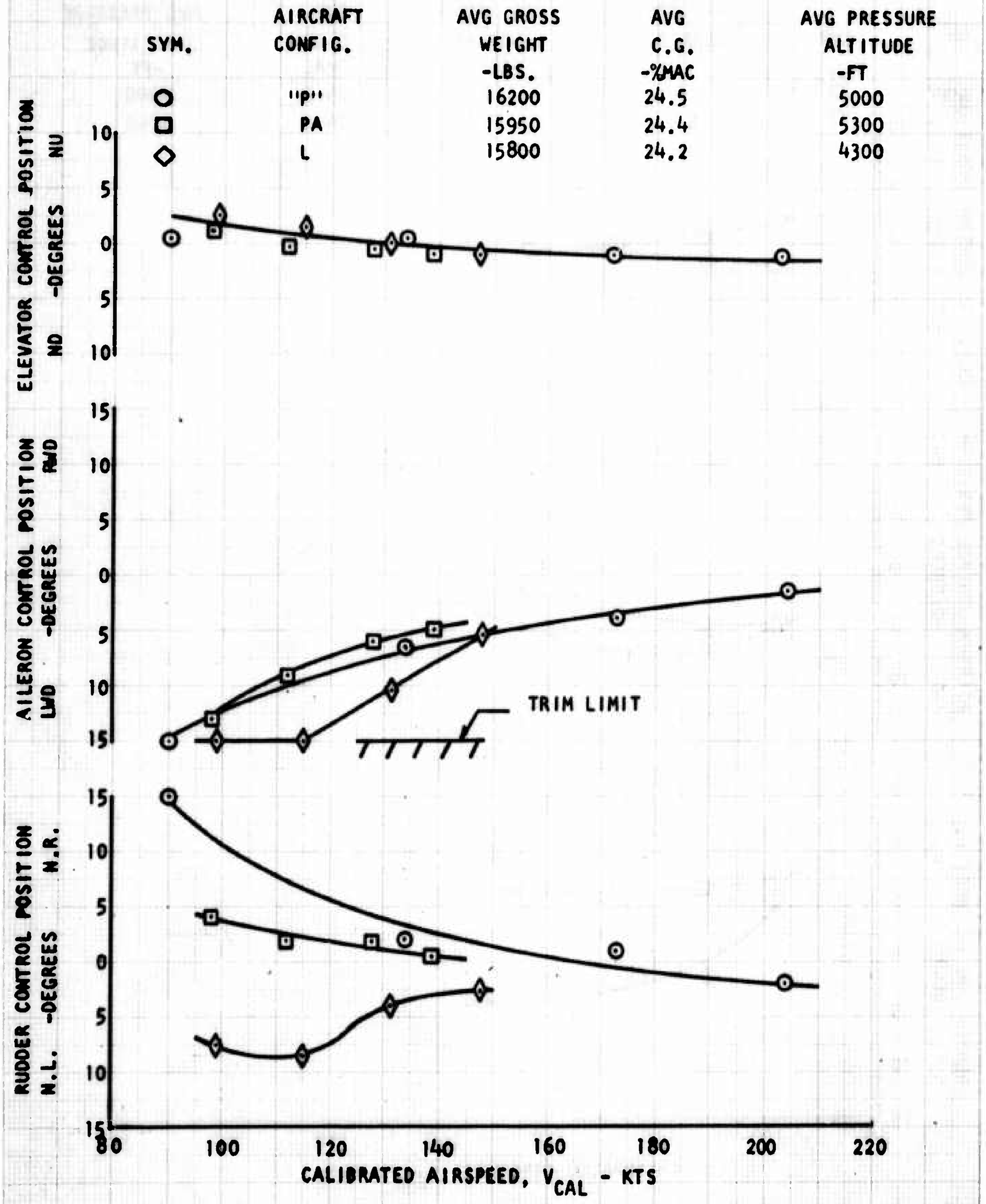


FIGURE No. 70
TRIMMABILITY
OV-10 (PRE-PRODUCTION) USA S/N 67-18899
CONFIGURATION C

SYM	AIRCRAFT CONFIG.	AVG GROSS WEIGHT -LBS	AVG C.G. -%MAC	AVG PRESSURE ALTITUDE -FT
□	PA	15550	24.0	5200
◇	L	15500	24.0	3000

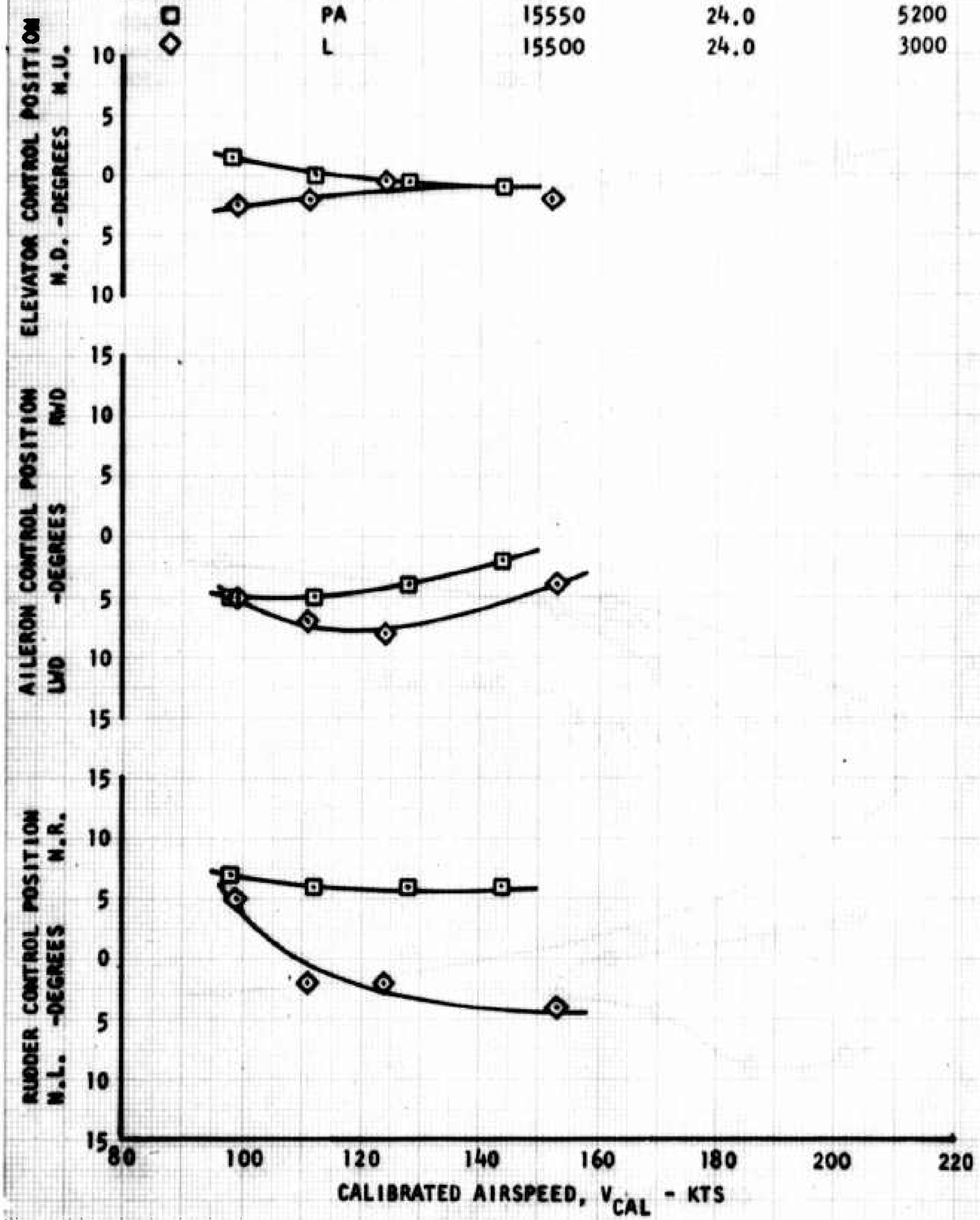


FIGURE No. 71
MILITARY RATED POWER AVAILABLE COMPARISON
STATIC - UNINSTALLED CONDITIONS

NOTE:

1. Hot Day definition obtained from Air Force - Navy Aeronautical (ANA) Bulletin 421, Reference MIL-C-8678 (AER).

2. T53-L-15 power available obtained from Model Specification 104.35.

3. T53-L-701 power available obtained from Model Specification 104.39.

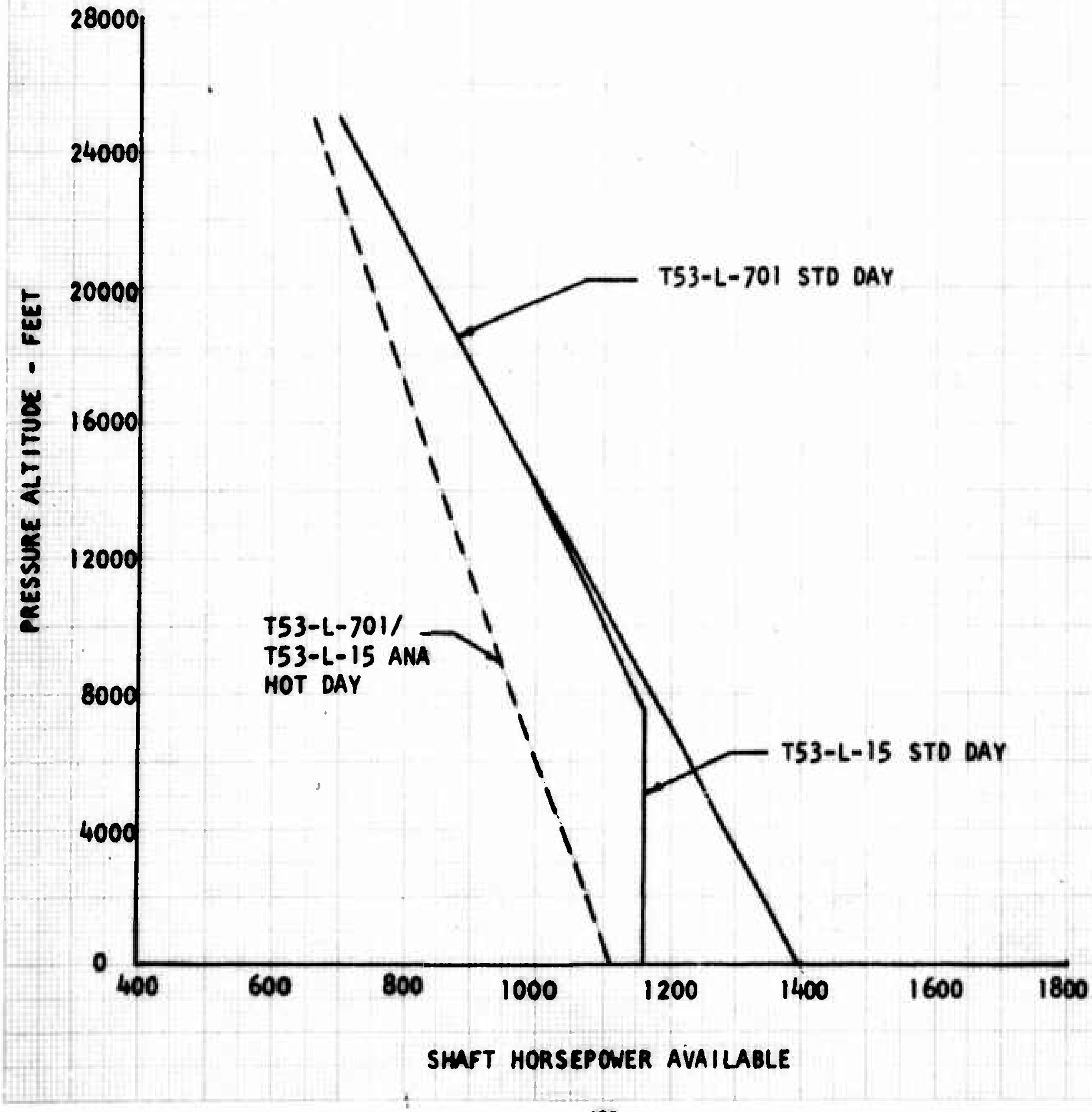


FIGURE No. 72
AIRSPEED CALIBRATION
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
STANDARD SHIPS SYSTEM

POWER APPROACH CONFIGURATION

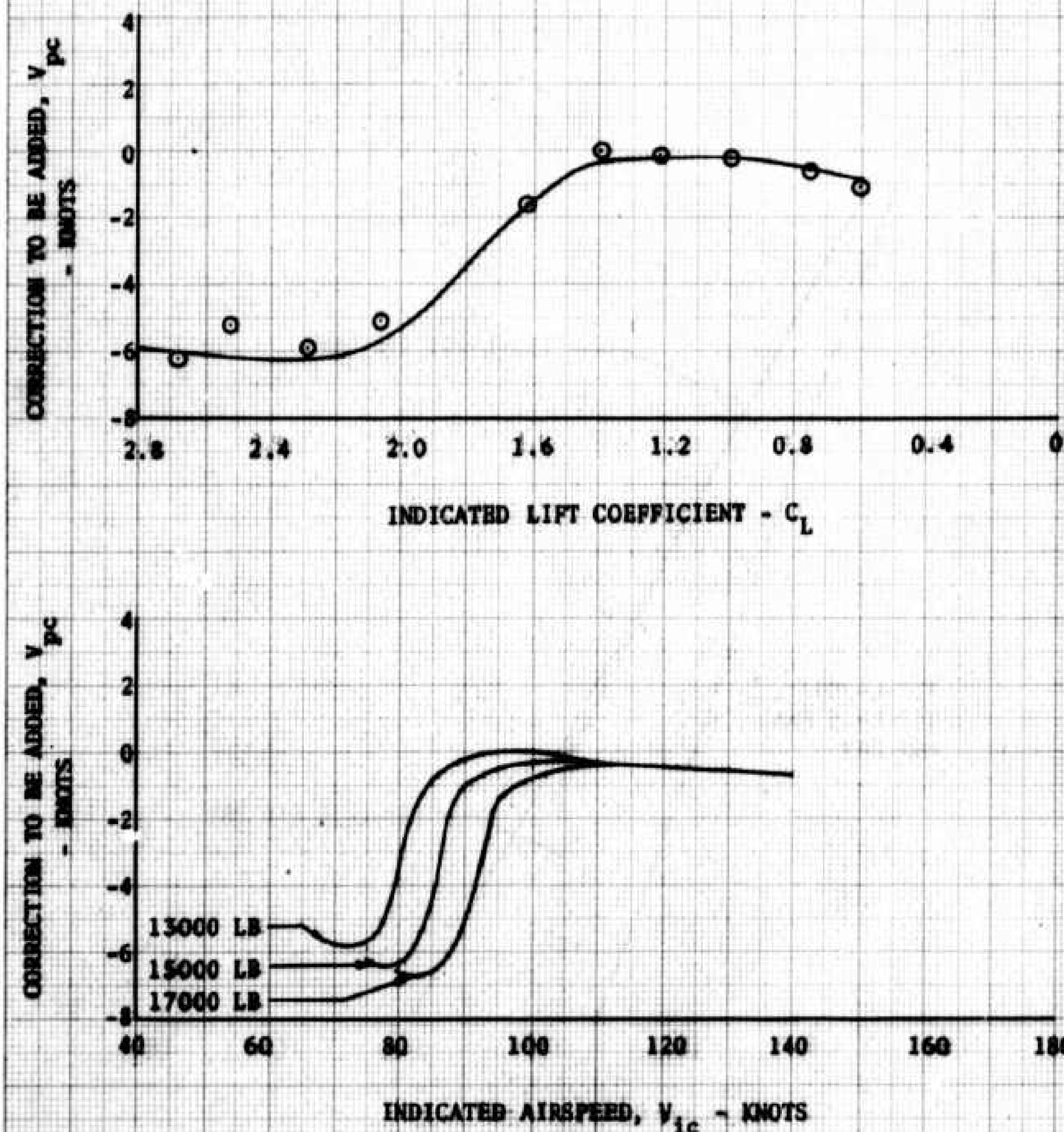


FIGURE No. 73
AIRSPEED CALIBRATION
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
STANDARD SHIPS SYSTEM

CRUISE CONFIGURATION

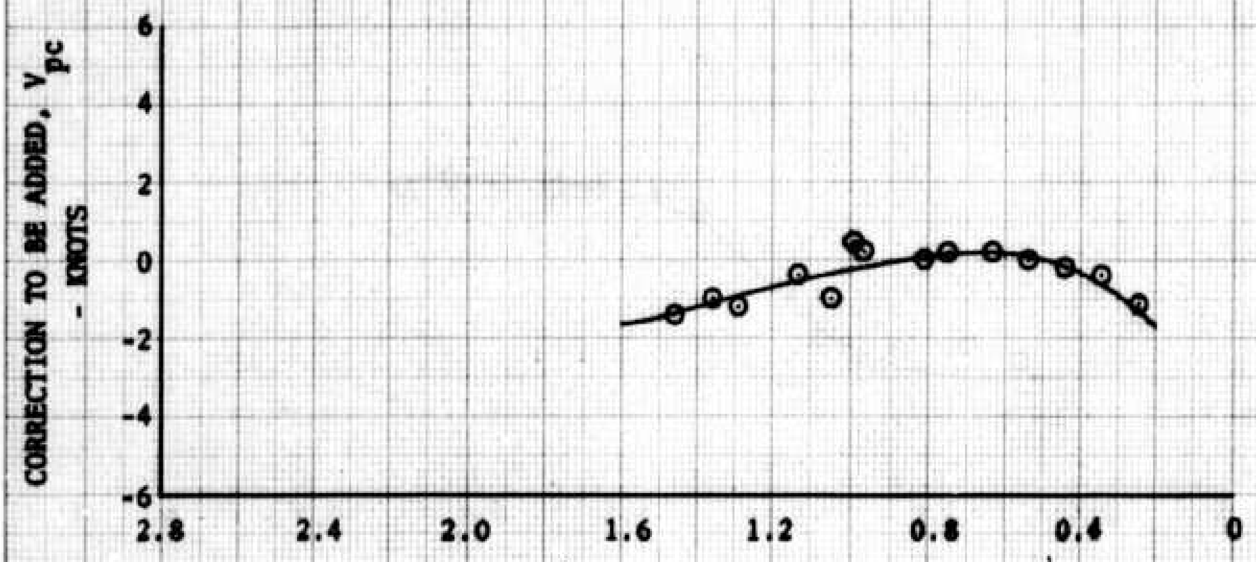
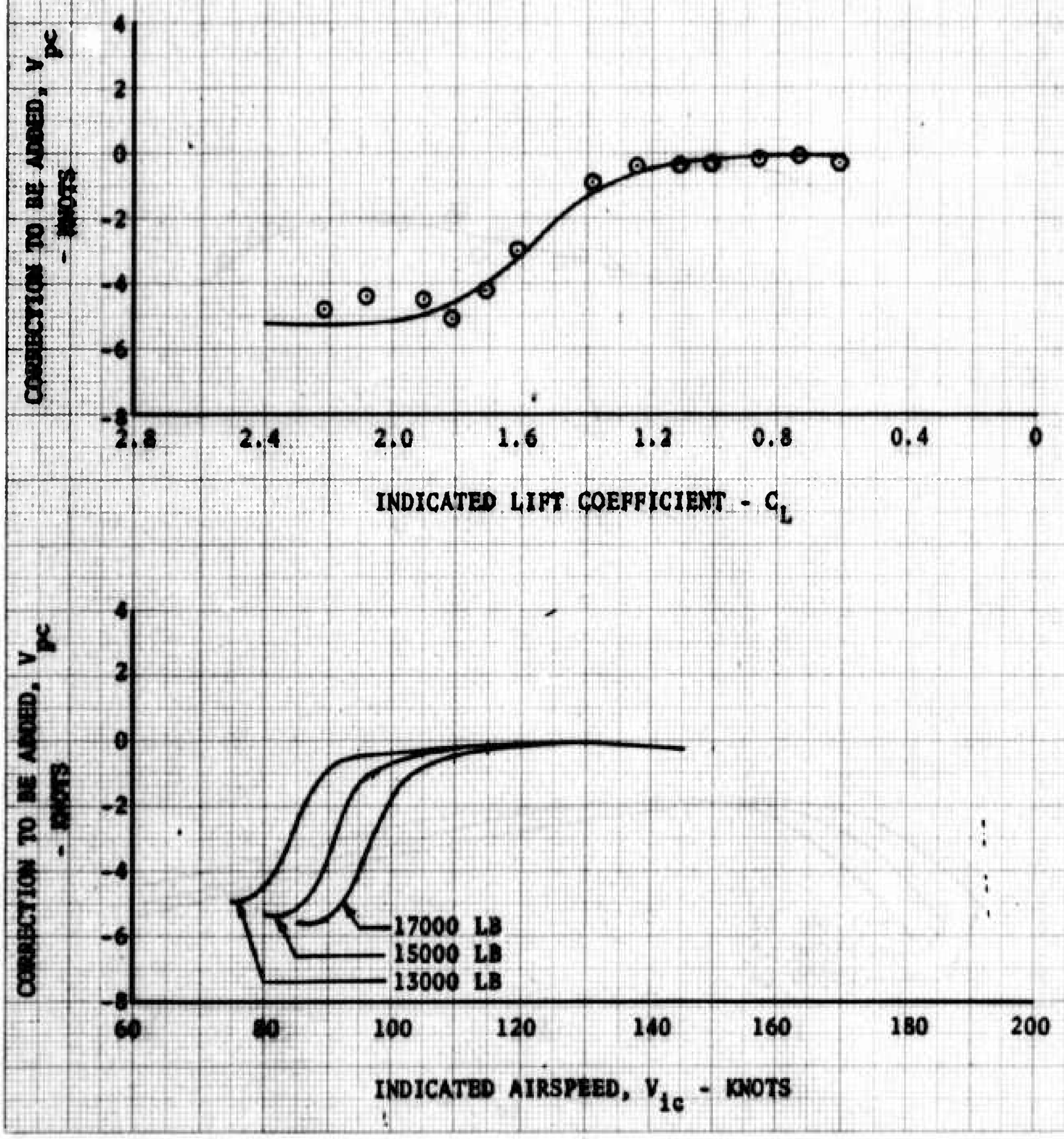


FIGURE No. 74
AIRSPEED CALIBRATION
OV-1D (PRE-PRODUCTION) USA S/N 67-18899
STANDARD SHIPS SYSTEM

TAKEOFF CONFIGURATION



APPENDIX III. TEST INSTRUMENTATION

Parameter	Cockpit	Photopanel	Magnetic Tape
Mach Number (test system)	X		
Airspeed (test system)	X	X	
Altitude (test system)	X	X	
Rudder pedal force	X		X
Rudder pedal full throw lights	X		
Angle of sideslip (nose boom)	X		X
Normal acceleration	X		
Time correlation	X	X	X
Frame counter	X	X	
Tape remaining	X		
Angle of attack (nose boom)	X		X
Fuel quantity	X	X	
ΔP Nose boom static and production static		X	
Outside air temperature		X	
Left engine torque pressure		X	
Right engine torque pressure		X	
Left propeller rpm		X	
Right propeller rpm		X	
Left/right engine fuel flow		X	
ΔP Nose boom total and production total		X	
Left/right engine exhaust gas temperature		X	
Lateral stick position			X
Lateral stick force			X
Longitudinal stick force			X
Yaw rate			X
Pitch rate			X
Roll rate			X
Bank angle			X
Pitch attitude			X
Center rudder position			X
Elevator position			X
Left outboard aileron position			X
Cg normal acceleration			X
Pilot's voice[1]			
Left/right rudder position			X
Center rudder tab position		X	
Left/right gas producer speed (N_1)			

[1]Recorded at the ground station when telemetry was ON.

APPENDIX IV. TEST CONDITIONS

PERFORMANCE

Type of Test	Stores Config	AC Config	Weight (lb)	CG (in.)	Altitude (ft)
1. Level flight (dual engine)	A	CR	15500	25.8	5000
	A	CR	15700	25.8	10000
	A	CR	15700	25.8	15000
	B	CR	16000	26.0	5000
	C	CR	15900	26.0	5000
2. Level flight (single engine)	A	CR	14500	25.2	5000
	C	CR	15100	25.6	5000
3. Stall	A	G	16100	30.2	5000
	A	CR	15950	30.2	5000
	A	L	16050	30.2	5000
	A	PA	15750	30.2	5000
	C	G	16150	30.2	5000
	C	CR	16050	30.2	5000
	C	L	16050	30.2	5000
	C	PA	15900	30.2	5000
4. Single engine climb	A	CR	16000	25.0	10700
	A	CR	16000	25.0	7000
	A	CR	15700	25.0	5000
	A	TO	16000	25.0	5000
	C	CR	16000	25.0	14000
	C	CR	16000	25.8	5000
	C	TO	16000	25.0	5000

STABILITY AND CONTROL

Type of Test	Stores Config	AC Config	Weight (lb)	CG (in.)	Altitude (ft)
5. Static longitudinal stability	A	CR	16500	29.2	4850
	A	CR	17300	24.0	4900
	A	L	15500	28.7	5000
	A	L	16700	24.7	3300
	A	P	17100	24.7	5000
	A	WO	15300	28.7	5000
	A	WO	16750	24.7	4000
	A	PA	16500	24.6	4500
	A	PA	16150	29.0	4660
	C	CR	16600	31.6	4850

		C	CR	16500	24.3	5000
		C	WO	15300	31.2	7000
		C	PA	15900	24.3	4480
		C	PA	15560	31.4	5300
6.	Static lateral-directional stability	A	CR	15100	25.5	5070
		A	P	16400	25.9	5040
		A	L	14800	25.3	5000
		A	P(c)	14500	25.0	4890
		A	WO	14300	25.0	5150
		A	PA	15400	25.7	5030
		C	CR	15350	25.6	5150
		C	PA	15700	31.4	5900
7.	Dynamic longitudinal stability	A	CR	17100	24.8	4950
		[illegible]	CR	16375	29.2	4850
		C	CR	16500	24.4	4975
		C	CR	16475	31.6	5000
8.	Dynamic lateral-directional stability	A	CR	15850	24.2	5250
		A	PA	15250	24.0	5000
		A	L	14775	23.9	5275
		C	P	15250	25.6	5225
		C	CR	15025	25.4	5100
		C	PA	14700	25.2	4875
		C	L	14700	25.2	5025
9.	Spiral stability	C	CR	14500	32.0	5000
		C	CR	14830	25.0	4820
		A	CR	15700	25.5	5000
		A	PA	15500	25.3	5000
10.	Lateral control	A	CR	16650	24.9	2600
		A	PA	17200	24.8	5100
		C	PA	14750	25.4	4900
		C	CR	15750	29.0	4900
11.	V_{MC}	A	CR	16775	29.2	5100
		A	TO	16625	29.2	4700
		A	WO	15150	28.9	4900
		C	CR	16650	29.7	5425
		C	TO	16475	29.8	4800
12.	Maneuvering stability	A	P	16750	29.2	5800
		A	D	15250	28.7	6340
		A	PA	15980	29.1	5040
		A	CR	16400	29.1	5900

	C	D	15620	29.8	5830
	C	P	16040	31.4	4210
	C	PA	15675	31.4	5575
	C	CR	16860	31.2	4640
13. Trimmability	A	P	16200	24.5	5000
	A	PA	15950	24.4	5300
	A	L	15800	24.2	4300
	C	PA	15550	24.0	5200
	C	L	15550	24.0	3000
14. Longitudinal trim changes	A	-	15475	24.0	3935
	C	-	16050	23.0	5460

APPENDIX V. SAFETY OF FLIGHT RELEASE

DEPARTMENT OF THE ARMY
US ARMY AVIATION SYSTEMS COMMAND
PO BOX 209, ST. LOUIS, MO. 63166

AMSAV-R-FF

26 April 1969

SUBJECT: Safety of Flight Release for Preproduction OV-1D Army Preliminary Evaluation

Commanding Officer
US Army Aviation Systems Test Activity
ATTN: SAVTE-P
Edwards AFB, California 93523

1. This letter constitutes a safety of flight release for the conduct of an Army Preliminary Evaluation by USAASTA on preproduction OV-1D S/N 67-18899.

2. Aircraft flight envelope and operating limitations shall be in accordance with the attached.

FOR THE COMMANDER:

1 Incl
as

CHARLES C. CRAWFORD, JR.
Director, Flight Standards
and Qualification

PREPRODUCTION OV-1D PRELIMINARY
FLIGHT ENVELOPE TO BE USED FOR
ARMY PRELIMINARY EVALUATION

1. Operating Weights:

a. Maximum Take-Off 17,790 lbs.

b. Maximum Landing Figure 1

2. Center-Of-Gravity Limits:

a. Without APS-94( ) SLAR; with or without other stores.

Maximum Forward 22.0% MAC Maximum Aft 31.0% MAC

b. With APS-94( ) SLAR; with or without other stores.

Maximum Forward 24.0% MAC Maximum Aft 29.3% MAC

3. Airspeed Limitations: (all airspeeds in this envelope are test boom indicated airspeeds) Figure 2.

a. Gear and Flaps Retracted

(1) Clean Aircraft (no external stores) 385 KIAS/.65M.

(2) Aircraft with external fuel tanks only 365 KIAS/.62M.

(3) Aircraft with external stores other than fuel tanks 350 KIAS/.62M.

b. Gear and Flaps Extended 145 KIAS.

c. In severe turbulence 145 KIAS.

d. Propeller unfeather limit 145 KIAS.

4. Acceleration Limitations:

a. Gear and Flaps Retracted

(1) Gross Weight 13,913 lbs. or below

(a) Symmetrical

1. 180 KIAS and above -1.56g to 4.0g

2. Below 180 KIAS Figure 4

(b) Unsymmetrical	0g to 3.2g
(2) Cross Weight above 13,913 lbs	Figure 3
b. Gear and Flaps Extended	0 to 2.0g
c. Severe turbulence	+.5g to +1.5g

5. Maneuver Limitations

a. Rolling

(1) Gear and Flaps Retracted.

(a) Clear Aircraft or with external fuel tanks only.

1 250 KIAS and below: Full abrupt 360° rolls.

2 365 KIAS and below: Full abrupt +60° rolls.

(b) Aircraft with external stores other than tanks, Figure 5.

(2) Gear and Flaps Extended

All configurations ±60° banks

b. Sideslips

(1) Gear and Flaps Retracted

(a) Clean aircraft or with external fuel tanks only.

1 Below 180 KIAS - ±15°

2 180 KIAS to 365 KIAS - Full pedal or 300 lb. pedal force.

(b) Aircraft with external stores other than fuel tanks.

1 Below 180 KIAS - ±15°

2 180 KIAS to 350 KIAS - Full pedal or 300 lb. pedal force.

(2) Gear and Flaps Extended - ±15°

c. Crosswing Take-off and Landings - All configurations with LS-59A Flasher Pod on wing store station 5 and ALQ-80 Pod on wing store station 6 are limited to a 15 knot cross wind component. Limit is due to handling qualities with asymmetric loading, especially for a wind from the left side.

d. Stalls - Unaccelerated level stalls are permitted for all configurations at power settings up to and including normal rated power. Stalls at higher power settings are prohibited due to extreme nose-high attitudes at stall.

e. Prohibited Maneuvers -

(1) Intentional Spins

(2) Abrupt (maximum pilot effort) full control reversals.

(3) Negative load factors or inverted flight for more than 30 seconds

(4) Zero "g" operation for more than 10 seconds.

(5) Military Rated Power Stalls.

6. Landing Sink Speed Limitations — Figure 1

7. Jettison Limits:

ALQ-80, Station 6

LS-59A, Station 5

Sargent-Fletcher Tanks, Stations 3 and 4. (empty or full)

a. Single Drops (with or without adjacent stores)

(1) Level unyawed flight — up to 225 KIAS

(2) up to 6° sideslip

b. Salvo Jettison (tanks empty or full)

up to 6° sideslip — 80 KIAS

8. Engine Limits — Table 1

9. Approved Store Installation

Store Station:	1	2	3 & 4	5	6
Store:	ALQ-67	Empty	150 gal. tank	LS-59A	ALQ-80

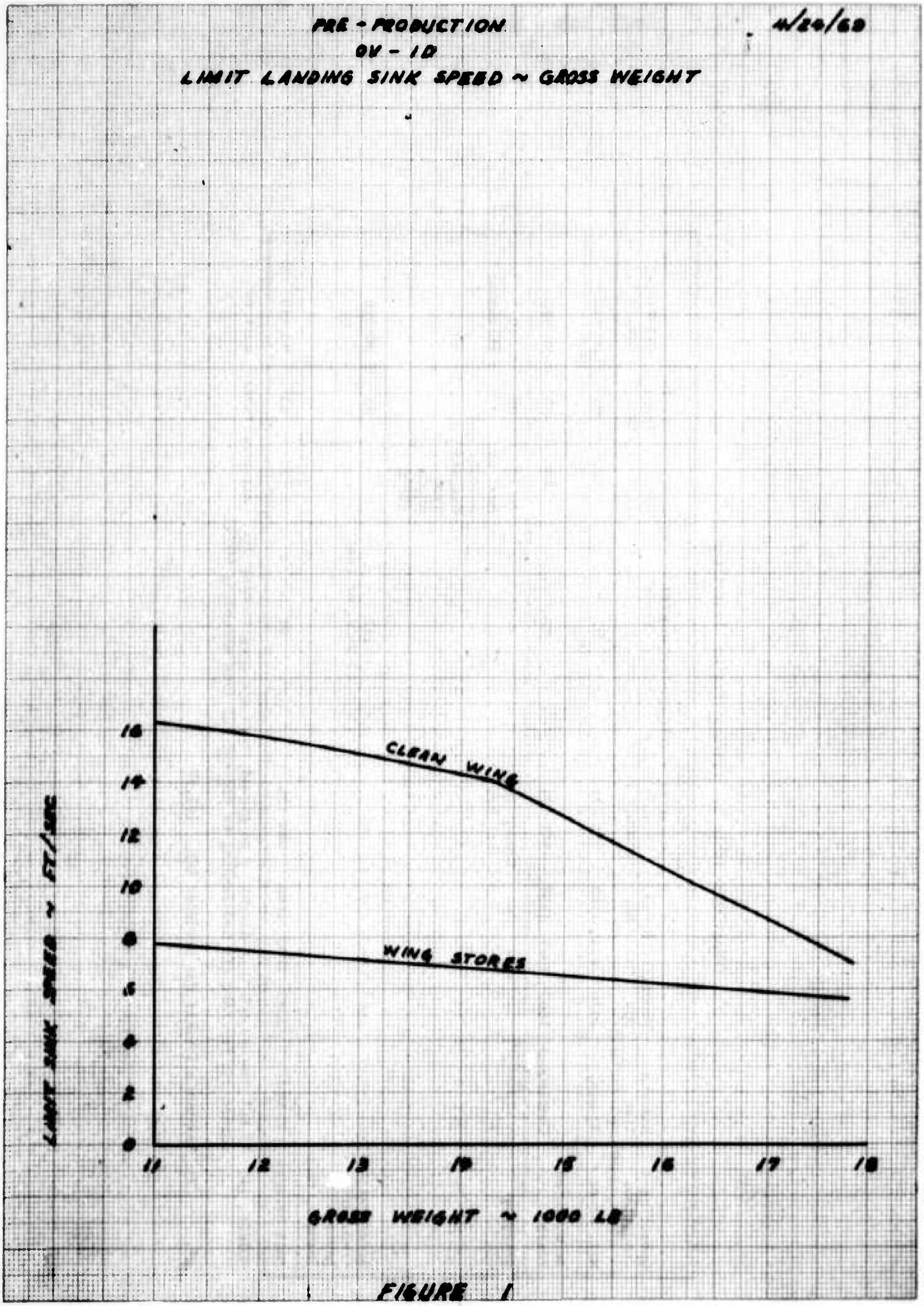
Fuselage: SLAR

(USAAVSCOM) Table 1. T53-L-15 Engine Limitations

Operating Conditions	Maximum Time	Propeller R.P.M. Opt.	Max.	Min.	Gas Producer R.P.M. Sea Level Static Standard Day Standard Engine (2)	Torquemeter Diff. Press. Max. P.S.I.G.	E.G.T. Max. C (1)	Oil in Temp. Max. C	Oil Press. Max. P.S.I.G.
Mil. Power	30 min.	1678	1693	1150	98% ±2%	97	625	93	90 ±10
Norm. Rated Power	Continuous	1600	1693	1150	94% ±2%	89	610	93	90 ±10
Starting	--	--	--	--	Ground Idle 52% ±2%	--	760°C Max. or 5 Secs. Elapsed Time Above 676°C	93	10 (Minimum)
Acceleration (Fwd. or Reverse Thrust)	--	--	--	--	--	157 (2 Secs. or Less)		93	90 ±10
Full Reverse	30 Min.	1680	1700	1660	98% ±2%	97	625	93	90 ±10

NOTES: (1) If EGT reaches 600°C in-flight or on ground, turn air-conditioning off. Air-conditioning must be turned off for take-off and landing to prevent EGT from exceeding 600°C.

(2) Maximum allowable gas producer RPM - 101.5%



PRE - PRODUCTION
OV - 1D
LIMIT LANDING SINK SPEED ~ GROSS WEIGHT
4/24/68
CLEAN WING
WING STORES
LIMIT SINK SPEED ~ FT/SEC
0
2
4
6
8
10
12
14
16
11
12
13
14
15
16
17
18
GROSS WEIGHT ~ 1000 LB

FIGURE 1

6/24/68

PRE - PRODUCTION
OV - 10
AIRSPEED - ALTITUDE LIMITATIONS

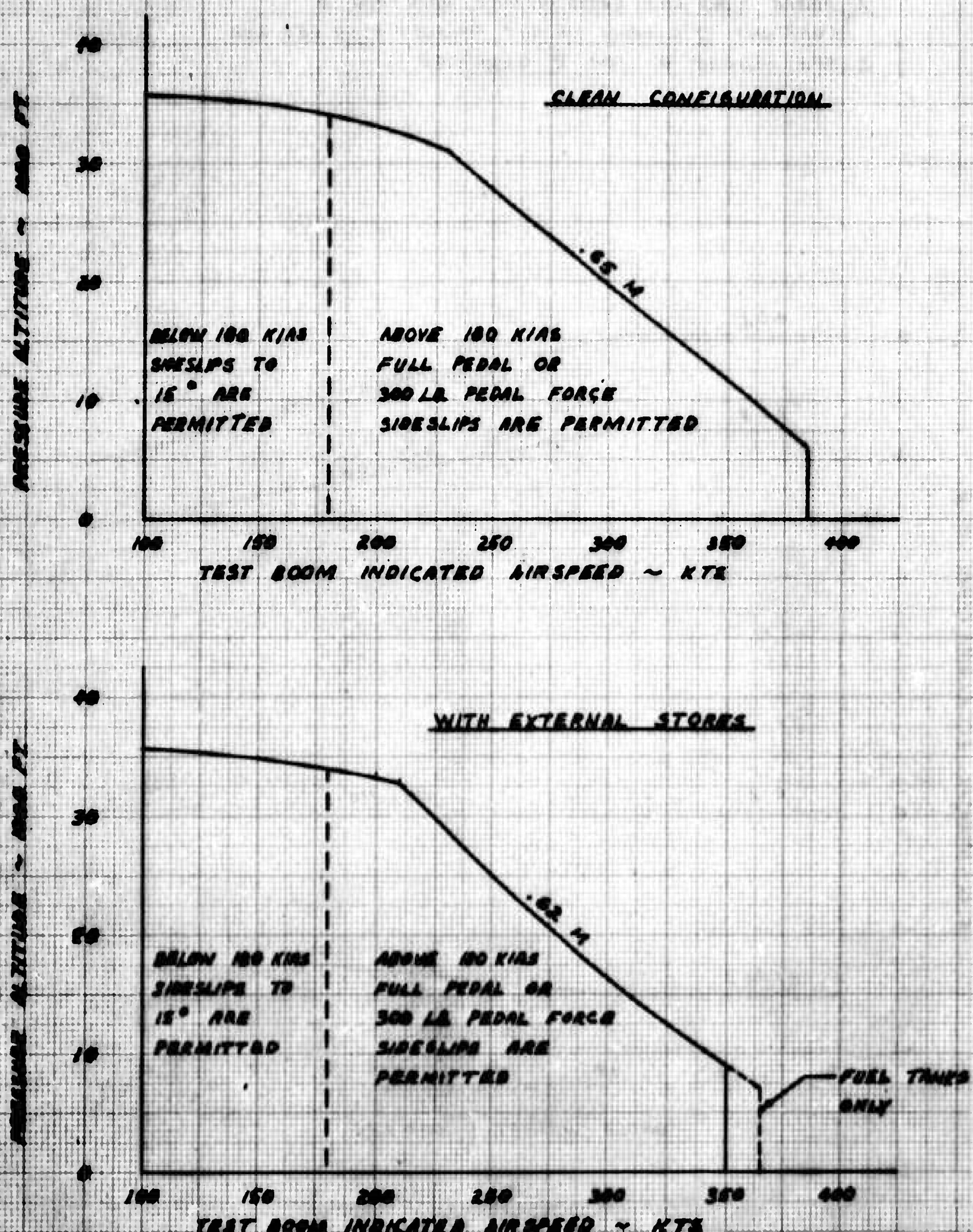


FIGURE 2

4/24/69

PRE - PRODUCTION

OV-1D

ACCELERATION - GROSS WEIGHT

NOTES:

1. ABOVE 13,913 LBS GROSS WEIGHT MAINTAIN A CONSTANT g x GROSS WEIGHT PRODUCT = 55,650 LBS.
2. SEE FIGURE 4 FOR V_i < 180 KIAS

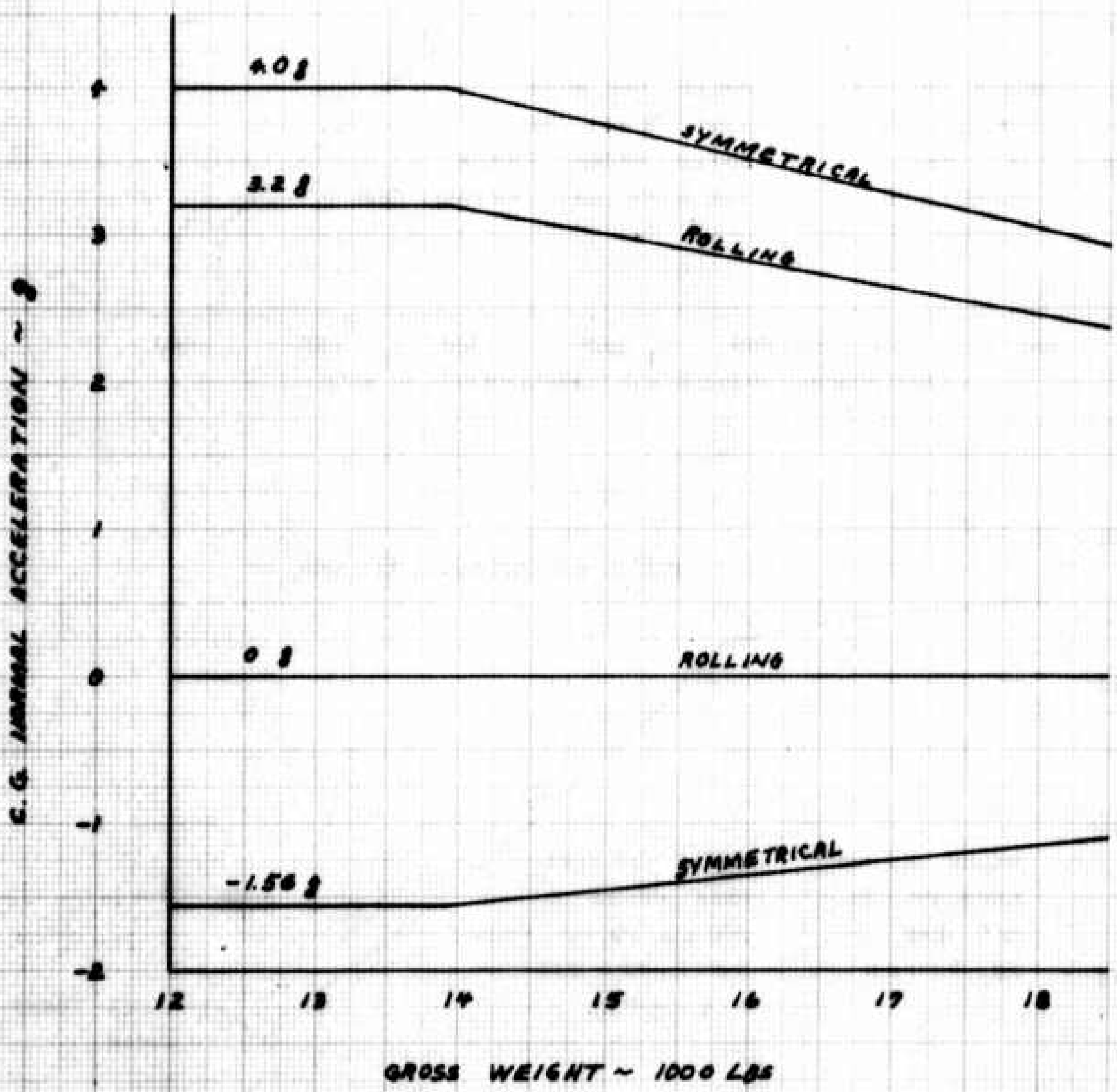


FIGURE 3

4/24/68

PRE - PRODUCTION

OV - 1D

AIRSPEED - ACCELERATION LIMITATIONS

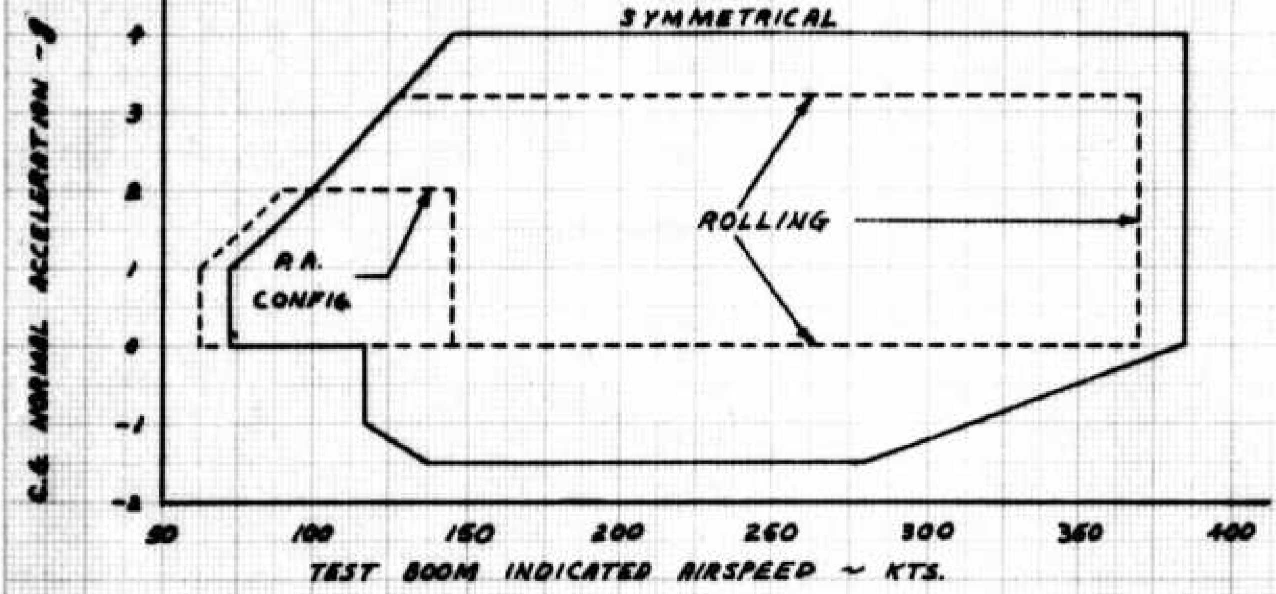
6000 FT

13,913 LB. G.W.

NOTES:

1. SEE FIGURE 2 FOR A/S LIMITS ABOVE 6000 FT.
2. SEE FIGURE 3 FOR LOAD FACTORS ABOVE 13,913 LBS.

CLEAN CONFIGURATION



WITH EXTERNAL STORES

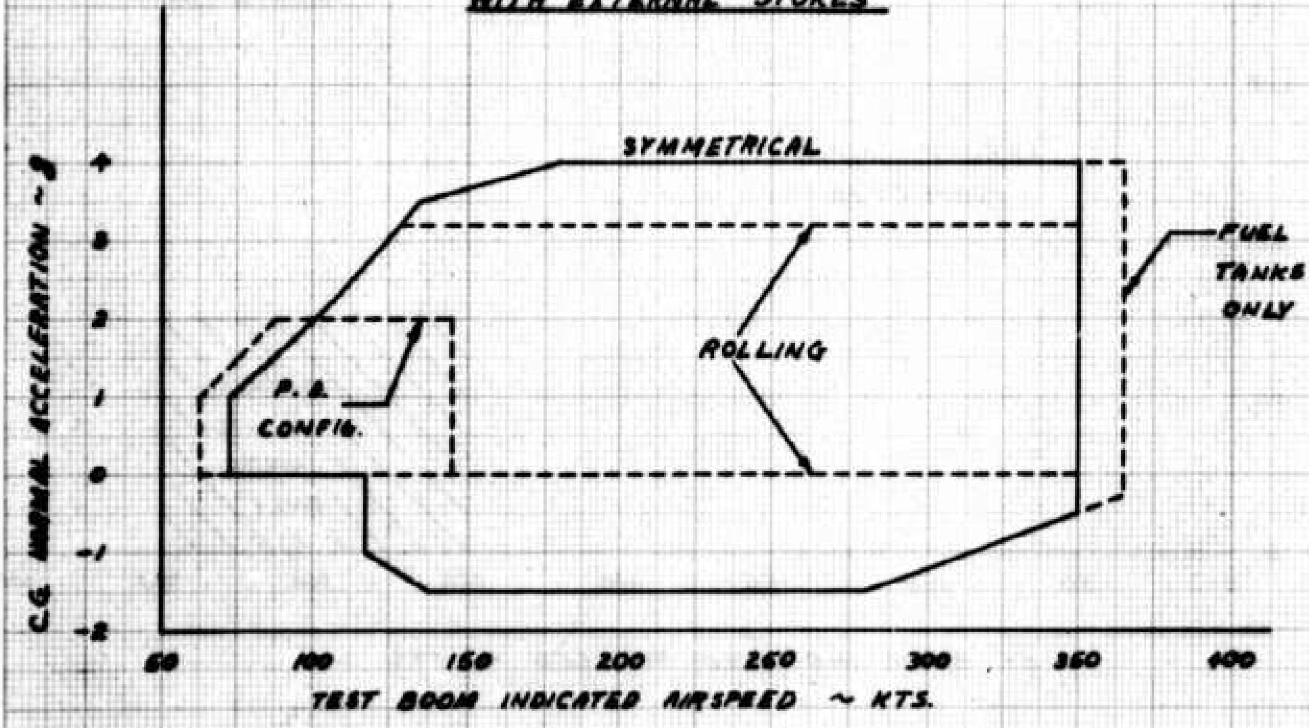


FIGURE 4

4/24/69

PRE-PRODUCTION
OV-1D
ROLLING RESTRICTION

NOTES:

1. APPLIES TO ALL CONFIGURATIONS HAVING APS-94(D) SLAR AND/OR LS-59A FLASHER POD.
2. ABRUPT = MAXIMUM PILOT EFFORT
3. GRADUAL = CONTROL INPUT NOT LESS THAN 2.0 SECONDS.

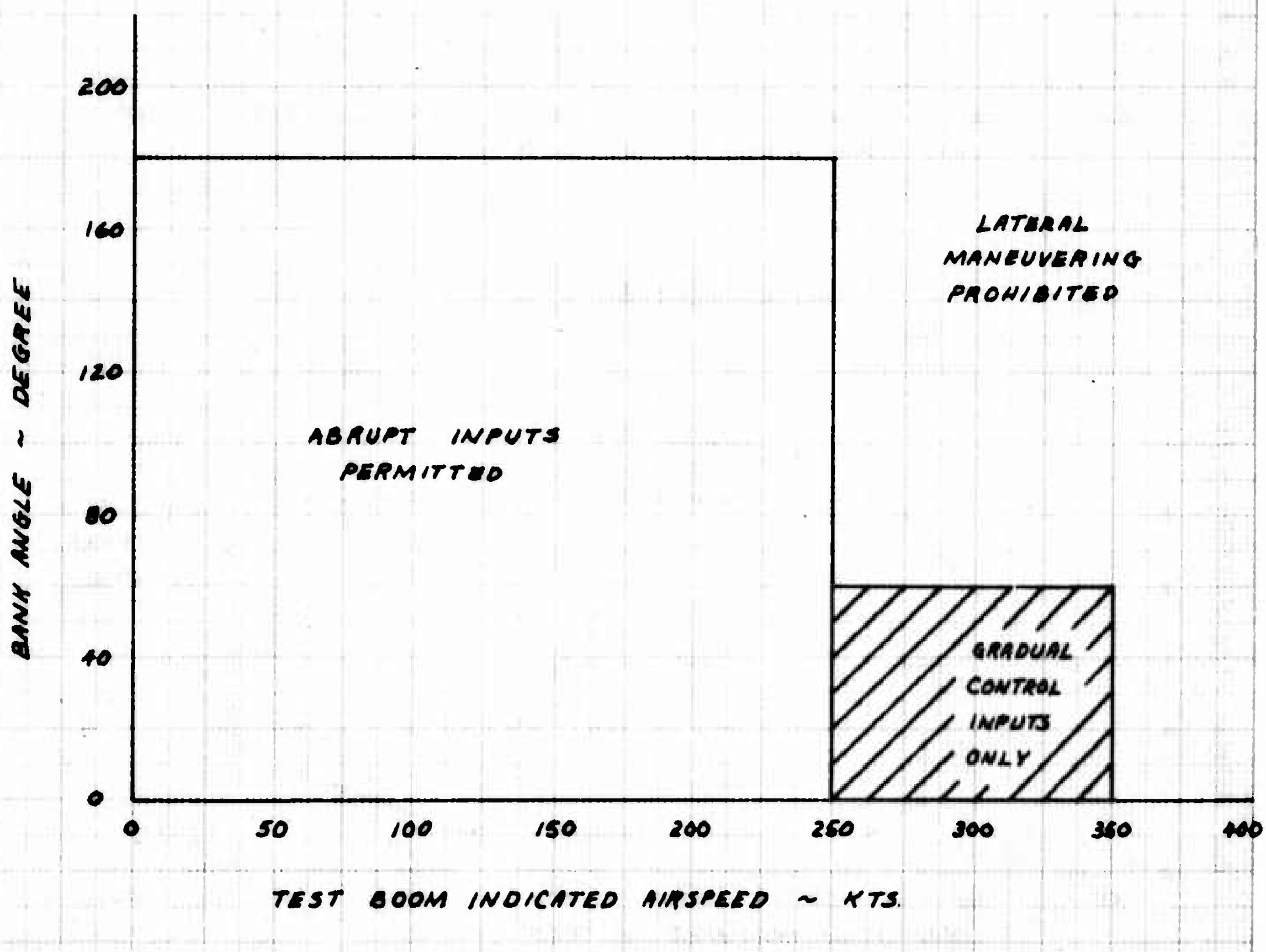


FIGURE 5

APPENDIX VI. SPECIFICATION NONCOMPLIANCE CHECK SHEET

APPENDIX VI. SPECIFICATION NONCOMPLIANCE CHECK SHEET

Type of Test	Specification MIL-F-8785(ASG)	Paragraph	Store Config	Result
Static lateral-directional stability	Linear $\pm 15^{o}$sideslip	3.4.4	A & C	Linear approx $\pm 10^{o}$sideslip
Stall	Warnings between 1.05 and 1.15 times stall speed	3.6.3	A & C	Warning occurred at 1.03 times stall speed in landing configuration
Lateral control	$\frac{Pb}{2v}$ shall be greater than 0.09 in power configuration	3.4.16	A	Cruise config, R roll $\frac{Pb}{2v}$ = 0.085-0.086 Cruise config, L roll = 0.065-0.071 Cruise config, R&L roll = 0.064-0.079
	Adverse yaw shall not exceed 15^{o} during a pedal-fixed abrupt roll	3.4.9	A C	PA config, R roll = 17.5^{o} PA config, R roll = 17^{o} PA config, L roll = 16.5^{o}
Trimmability	Capable of reducing all control forces to zero in the landing configuration at speed greater than 1.4 times stall speed	3.5.4	A	Zero pedal force capability occurred at 1.5 times stall speed
Maneuvering stability	Stick force gradient per "g" above 10.94	3.3.9	C	Force gradient approx 9.99.

APPENDIX VII. PILOT RATING SCALE

<table>
<tr><td rowspan="6">CONTROLLABLE
CAPABLE OF BEING CONTROLLED OR MANAGED IN CONTEXT OF MISSION, WITH AVAILABLE PILOT ATTENTION</td><td rowspan="6">ACCEPTABLE
MAY HAVE DEFICIENCIES WHICH WARRANT IMPROVEMENT, BUT ADEQUATE FOR MISSION.
PILOT COMPENSATION, IF REQUIRED TO ACHIEVE ACCEPTABLE PERFORMANCE, IS FEASIBLE.</td><td rowspan="3">SATISFACTORY
MEETS ALL REQUIREMENTS AND EXPECTATIONS, GOOD ENOUGH WITHOUT IMPROVEMENT
CLEARLY ADEQUATE FOR MISSION.</td><td>EXCELLENT, HIGHLY DESIRABLE</td><td>A1</td></tr>
<tr><td>GOOD, PLEASANT, WELL BEHAVED</td><td>A2</td></tr>
<tr><td>FAIR. SOME MILDLY UNPLEASANT CHARACTERISTICS. GOOD ENOUGH FOR MISSION WITHOUT IMPROVEMENT.</td><td>A3</td></tr>
<tr><td rowspan="3">UNSATISFACTORY
RELUCTANTLY ACCEPTABLE. DEFICIENCIES WHICH WARRANT IMPROVEMENT. PERFORMANCE ADEQUATE FOR MISSION WITH FEASIBLE PILOT COMPENSATION.</td><td>SOME MINOR BUT ANNOYING DEFICIENCIES. IMPROVEMENT IS REQUESTED. EFFECT ON PERFORMANCE IS EASILY COMPENSATED FOR BY PILOT.</td><td>A4</td></tr>
<tr><td>MODERATELY OBJECTIONABLE DEFICIENCIES. IMPROVEMENT IS NEEDED. REASONABLE PERFORMANCE REQUIRES CONSIDERABLE PILOT COMPENSATION.</td><td>A5</td></tr>
<tr><td>VERY OBJECTIONABLE DEFICIENCIES. MAJOR IMPROVEMENTS ARE NEEDED. REQUIRES BEST AVAILABLE PILOT COMPENSATION TO ACHIEVE ACCEPTABLE PERFORMANCE.</td><td>A6</td></tr>
<tr><td rowspan="3"></td><td rowspan="3">UNACCEPTABLE
DEFICIENCIES WHICH REQUIRE MANDATORY IMPROVEMENT. INADEQUATE PERFORMANCE FOR MISSION EVEN WITH MAXIMUM FEASIBLE PILOT COMPENSATION.</td><td rowspan="3"></td><td>MAJOR DEFICIENCIES WHICH REQUIRE MANDATORY IMPROVEMENT FOR ACCEPTANCE. CONTROLLABLE. PERFORMANCE INADEQUATE FOR MISSION, OR PILOT COMPENSATION REQUIRED FOR MINIMUM ACCEPTABLE PERFORMANCE IN MISSION IS TOO HIGH.</td><td>U7</td></tr>
<tr><td>CONTROLLABLE WITH DIFFICULTY. REQUIRES SUBSTANTIAL PILOT SKILL AND ATTENTION TO RETAIN CONTROL AND CONTINUE MISSION.</td><td>U8</td></tr>
<tr><td>MARGINALLY CONTROLLABLE IN MISSION. REQUIRES MAXIMUM AVAILABLE PILOT SKILL AND ATTENTION TO RETAIN CONTROL.</td><td>U9</td></tr>
<tr><td colspan="3">UNCONTROLLABLE
CONTROL WILL BE LOST DURING SOME PORTION OF MISSION.</td><td>UNCONTROLLABLE IN MISSION.</td><td>10</td></tr>
</table>

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13. ABSTRACT

An Army Preliminary Evaluation of the preproduction OV-1D airplane (Mohawk), S/N 67-18899, was conducted by the US Army Aviation Systems Test Activity. During the period of this test, 33.9 hours were flown between 29 April 1969 and 14 May 1969 at Calverton, New York. The objective of this test was to evaluate performance and handling qualities of the airplane in various external store configurations. Inadequate single engine performance was the only deficiency noted. The airplane will not climb in the takeoff configuration with one engine feathered. There were also three major shortcomings noted. Pedal forces were excessive with one engine feathered. Stall warning margins in the landing and power approach configurations were insufficient. The lack of a cockpit accelerometer prevents the monitoring of "g" loads by the pilot. The vertical tape display instruments in the production OV-1D are a significant improvement over the previously used round dials.

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	ROLE	WT	ROLE	WT	ROLE	WT
Army Preliminary Evaluation Preproduction OV-1D Airplane (Mohawk) Performance and handling qualities Various external stores Inadequate single engine performance Three major shortcomings Pedal forces Stall warning margin Cockpit accelerometer						

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